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ABSTRACT

Described are the activities, responsibilities, and educational requirements of approximately 100 technical occupations directly concerned with environmental protection. Each career description is listed under its preferred title and divided into three sections. The opening section describes job duties, places of employment, and areas of specialization. A section on job requirements provides information on required professional and paraprofessional training, necessary or helpful special skills, state licensure, and other factors related to employment. Finally, the opportunities section indicates the employment outlook and opportunities for advancement. Included in the appendix is information on sources of financial assistance and a listing of postsecondary educational programs by state and type of pollution. (Author/WB)

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Environmental Protection Careers Guidebook

U.S. Department of Labor
Employment and Training Administration

U.S. Environmental Protection Agency

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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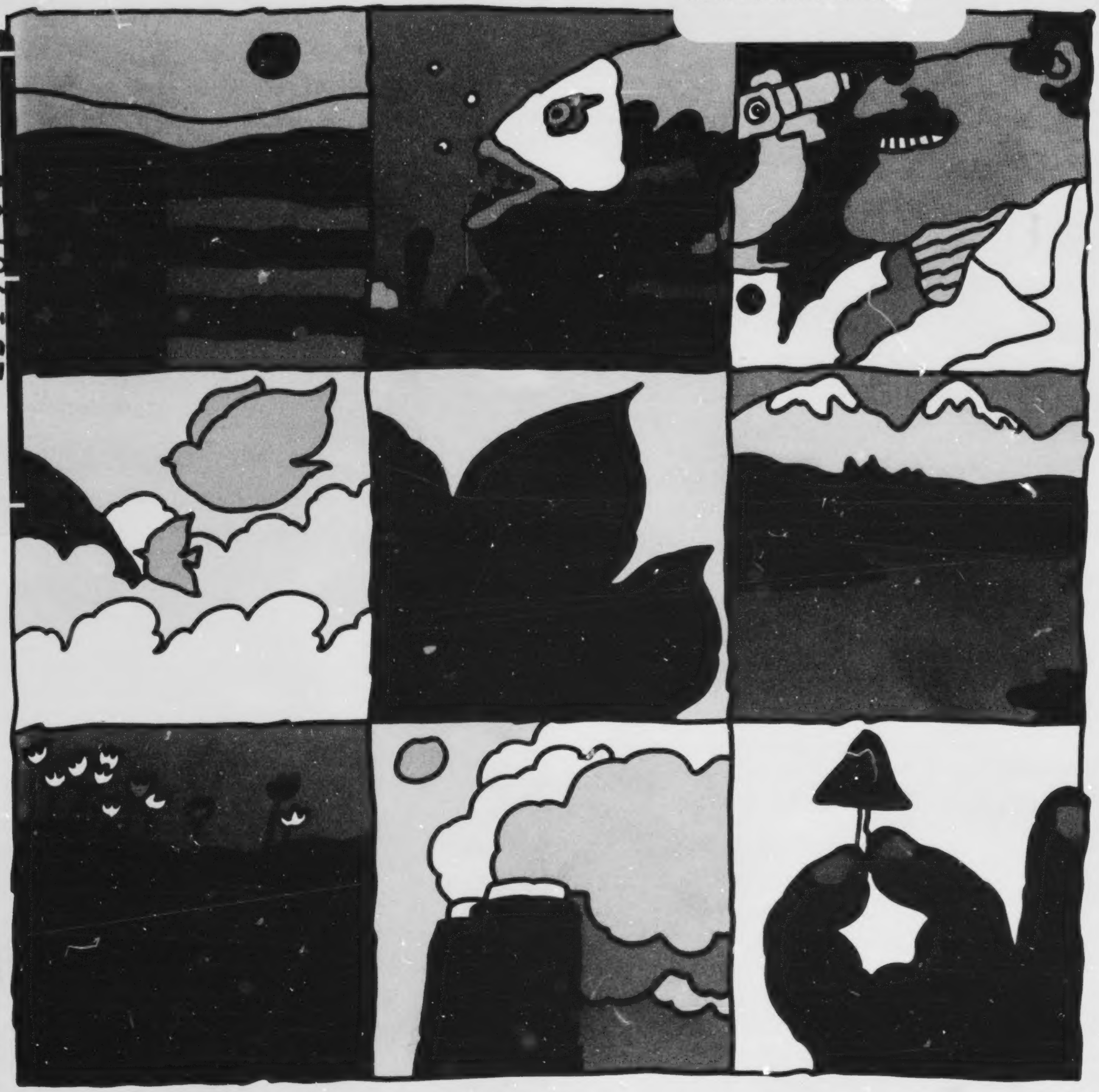

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Environmental Protection Careers Guidebook

U.S. Department of Labor
Ray Marshall, Secretary
Employment and Training Administration
1980

U.S. Environmental Protection Agency
Douglas M. Costle, Administrator

I am pleased to present this new publication, the *Environmental Protection Careers Guidebook*. The U.S. Department of Labor has always been responsive to the needs of the Nation's workforce and to the needs of our economy and social life. In this we recognize the impact upon our lives brought about by the emergence of environmental protection as one of the vital issues of our time. Our growing knowledge of the effects of our daily activities upon the environment has increased the demand for action in environmental protection and preservation of our environmental resources. This has been reflected by the need for more knowledge and an increasing interest in all occupations concerned with environmental protection.

To make possible the translation of these needs into activities which will bring about the effective management of our environment, the U.S. Department of Labor and the U.S. Environmental Protection Agency have merged their technical and informational resources to produce, as a cooperative enterprise, this *Environmental Protection Careers Guidebook*.

The *Guidebook* provides both overviews and descriptions in detail of the activities, responsibilities, and educational and training requirements of the major occupations directly concerned with environmental protection. Many of these occupations have never before been fully described to the public. The information has been developed and presented in a manner to make it readily accessible to a wide range of readers.

The counselor, the student, and other persons who want specific occupational and career information in the environmental field will find the *Guidebook* an important tool. May it prove the key to productive and satisfying careers for many Americans.

Ray Marshall

RAY MARSHALL
Secretary
U.S. Department of Labor

In today's complicated job market, individuals need the best possible information to help in making career decisions. They need assistance in selecting careers that provide adequate incomes, opportunities for individual growth, and feelings of personal usefulness. When a new career field emerges, particularly one that draws a great deal of interest from the student-age population, it becomes essential to provide uniform and current information on the opportunities and requirements in that field.

Environmental occupations have been in existence for a long time, but the recent emphasis on environmental protection has caused many changes as well as an expansion in environmentally related career fields. The U.S. Congress has passed laws directing a wide range of pollution control programs. The Environmental Protection Agency has been created to provide a broad, comprehensive approach to national environmental problems. States have passed pollution control laws of their own and have created their own environmental protection agencies. New pollution control techniques have been developed, and new facilities have been built. Most important, the heightened concern for the environmental conditions in which we live has caused us to consider new ways of applying greater human skills to environmental problems. The *Environmental Protection Careers Guidebook* will help students and counselors evaluate occupations in the light of these many changes.

As society develops and expands, greater skills are needed to carry out the mandate of the National Environmental Policy Act that human activity exist in "productive harmony" with the earth's biosphere. The U.S. environmental workforce, including both the public and private sectors, comprises over a million workers. The size of this workforce is growing, and the level of skills required to carry out national pollution control programs is increasing. The *Guidebook* provides information on over 100 different occupations, many of which did not exist a decade ago.

Besides describing environmental career fields, however, the *Guidebook* offers a unique perspective on environmental protection. While most publications on environmental subjects concern themselves with environmental problems, the *Guidebook* provides insight into solutions—jobs that help to correct the problems created by humans' interaction with the environment. The *Guidebook* will be of interest to any person seeking an introduction to the issues in environmental protection.

DOUGLAS M. COSTLE
Administrator
U.S. Environmental Protection Agency

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Government Sources

Federal

Federal Aviation Administration; Federal Highway Administration, Noise and Air Quality Branch; Tennessee Valley Authority, Division of Forestry, Fisheries, and Wildlife Development; U.S. Fish and Wildlife Service (Alaska Area Office); U.S. Bureau of Land Management (Alaska State Office); and U.S. Forest Service; Guam Environmental Protection Agency.

State

Alabama	Forestry Commission
Alaska	Department of Fish and Game Habitat Protection Department of Natural Resources, Division of Parks
Arizona	Department of Administration, Personnel Division Department of Health Services, Bureau of Air Quality Division of Environmental Health Services Game and Fish Department
Arkansas	Game and Fish Commission
California	Department of Food and Agriculture Department of Health Department of Health, Radiologic Health Section Department of Transportation, Office of Transportation Laboratory State Solid Waste Management Board
Colorado	Department of Health Department of Health, Water Quality Control Division
Connecticut	Department of Environmental Protection Department of Environmental Protection, Division of Conservation and Preservation Department of Transportation Department of Transportation, Bureau of Planning and Research
Delaware	Department of Natural Resources and Environmental Control
Florida	Department of Environmental Regulation
Georgia	Department of Natural Resources, Environmental Protection Division
Hawaii	Department of Agriculture
Idaho	Department of Health and Welfare: Air Quality Bureau, Division of Enforcement and Division of Environment
Illinois	Environmental Protection Agency
Indiana	State Board of Health
Iowa	Department of Environmental Quality
Kentucky	Bureau of Environmental Protection, Division of Air Pollution Control

	Department of Fish and Wildlife Resources Department of Natural Resources and Environmental Protection
Louisiana	Department of Health and Human Resources, Office of Health Services and Environmental Quality
Maine	Department of Personnel
Maryland	Department of Health and Mental Hygiene, Environmental Health Administration, Division of Radiation and Noise Control National Capital Park and Planning Commission Department of Natural Resources, Wildlife Administration
Massachusetts	Department of Environmental Management, Bureau of Solid Waste Disposal Department of Environmental Quality Engineering, Division of Air Quality Control Department of Public Health Executive Office of Environmental Affairs, Division of Law Enforcement
Michigan	Department of Natural Resources
Minnesota	Department of Transportation Pollution Control Agency
Missouri	Department of Natural Resources
Montana	Department of Health and Environmental Sciences, Air Quality Bureau and Environmental Science Division
Nebraska	Department of Environmental Control Game and Park Commission
Nevada	Department of Agriculture Department of Conservation and Natural Resources, Division of Environmental Protection
New Hampshire	Department of Health and Welfare, Division of Public Health Services and Occupational Health Service Department of Resources and Economic Development, Division of Forests and Lands Fish and Game Department Water Supply and Pollution Control Commission
New Jersey	Department of Environmental Protection Department of Environmental Protection, Bureau of Air Pollution Control and Water Resource Division
New Mexico	Health and Social Services Department, Environmental Improvement Agency
New York	Department of Environmental Conservation Department of Environmental Conservation, Division of Air Resources
North Carolina	Department of Natural Resources and Community Development, Air Quality Section
North Dakota	Department of Health

Ohio	Environmental Protection Agency
Oklahoma	State Department of Health, Air Quality Service
Oregon	Department of Agriculture Department of Environmental Quality
Rhode Island	Department of Environmental Management
South Carolina	Department of Health and Environmental Control Department of Health and Environmental Control, Bureau of Air Quality, and Bureau of Wastewater and Stream-Quality Control Wildlife and Marine Resources Department
South Dakota	Department of Environmental Protection
Tennessee	Air Pollution Control Division Department of Public Health
Texas	Air Control Board Department of Health, Division of Water Hygiene
Utah	Division of Health, Bureau of Air Quality
Vermont	Agency of Environmental Conservation, Division of Environmental Engineering
Virginia	Department of Health, Bureau of Occupational Health
Washington	Department of Agriculture Department of Ecology
West Virginia	Department of Natural Resources
Wisconsin	Department of Natural Resources

Regional

Fox Valley Water Quality Planning Agency, Neenah, Wis.; Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio

Local

Cities of Beaumont, Tex.; Buf[illegible] N.Y.; Houston, Tex., Department of Public Health, Air Pollution Control Program, Jacksonville, Fla., Department of Health, Welfare, and Bio-Environmental Services, Air and Water Pollution Control; Los Angeles, Calif., Department of Environmental Quality, Personnel Department, and City Sanitation Bureau; Metropolitan Washington, D.C., Council of Governments, Environmental Noise Program; New York Environmental Protection Administration; Philadelphia, Pa., Air Management Services; Hammond, Ind., Air Pollution Control; and San Diego, Calif., Civil Service Department and Noise Abatement and Control Administration.

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Industry and Business Sources

Air Pollution Technology, Inc., Calif.; Anheuser-Busch, Inc., St. Louis, Mo.; Chevron USA Inc., Environmental Affairs Group; E. J. DuPont deNemours and Co., Engineering Department, and Occupational Environmental Control Group, Del.; Lenox Hill Hospital Center for Communications Disorders, New York, N.Y.; Lockheed-California Company, Industrial Security and Safety; Mallinckrodt, Inc., St. Louis, Mo.; Richman, Edgerly, Tomlinson and Associates, a division of Envirodyne Engineers, St. Louis, Mo.; Rossnagel and Associates Engineering and Testing Consultants, N.J.; Shell Oil Company, Wood River Refinery, Wood River, Ill.; Southern California Edison Co., Rosemead, Calif.; and Sverdrup & Parcel and Associates, St. Louis, Mo.

Educational Sources

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Membership Groups Sources

American Board for Occupational Health Nurses, Inc.; American Speech and Hearing Association, Audiology Department; The Biometric Society; Council for Accreditation in Occupational Hearing Conservation; Environmental Action; Environmental Defense Fund; Friends of the Earth; Sierra Club; and Sierra Club Legal Defense Fund, Inc.

Photo Sources

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Contents

Page
Acknowledgments v
Introduction 3
  Problems in Environmental Protection 3
  Trends for the Future 7
  Environmental Careers 7
  Organization of Occupational Descriptions 8

Environmental Protection Occupations

Water and Wastewater 11
  Legislation 11
  Employment 12
  Water Treatment Occupations 13
    Chemist, Water Purification 13
    Meter Repairer 14
    Pump-Station Operator, Waterworks 14
    Supervisor, Waterworks 15
    Water-Filter Cleaner 16
    Water-Meter Reader 17
    Water-Treatment-Plant Operator 17
  Wastewater Treatment Occupations 18
    Chemist, Wastewater Treatment 19
    Industrial Waste Inspector 20
    Industrial Waste Sampler 21
    Laboratory Technician, Wastewater Treatment 21
    Microbiologist 22
    Photo-Inspection Technician, Wastewater Collection 23
    Sewage-Disposal Worker 23
    Sewer Maintenance Worker 24
    Superintendent, Wastewater-Treatment-Plant 25
    Supervisory Wastewater-Treatment-Plant Operator 26
    Treatment-Plant Mechanic 27
    TV Technician, Wastewater Collection 27
    Wastewater-Treatment-Plant Attendant 28
    Wastewater-Treatment-Plant Operator 29
    Water-and-Sewer Systems Supervisor 31
  Irrigation Occupations 31
    Basin Operator 31
    Ditch Rider 32
    Water Control Supervisor 33
    Watershed Tender 33
  Research, Development, and Design Occupations 34
    Aquatic Biologist 34
    Drafter, Water and Sewer 35
    Estuarine Resource Technician 36
    Hydrographer 37

Hydrologic Engineer 37
Hydrologist 38
Industrial-Water-Treatment Engineer 39
Oceanographer 40
Sanitary Engineer 41
Water Pollution Analyst 42
Water Pollution-Control Technician 44
Regulation and Control Occupations 45
Oil Pollution-Control Engineer 45
Water Pollution-Control Engineer 47
Water Pollution-Control Inspector 48
Treatment-Plant Instructor 49
Noise Control 53
Legislation 53
Employment 54
Occupations 54
Audiologist 54
Audiometrist 55
Noise Engineer 56
Noise Specialist 57
Noise Technician 57
Air Resource Management 61
Legislation 61
Employment 61
Occupations 62
Air Chemist 62
Air Engineer 63
Air Scientist 64
Air Technician 66
Air Technician, Meteorology 68
Biometrician 68
Meteorologist, Air Quality 69
Land, Fish, and Wildlife Management 73
Legislation 73
Employment 73
Occupations 74
Conservation Officer 74
Fish Biologist 75
Fish Culturist 76
Forester 77
Forest Technician 79
Land Planner 80
Landscape Architect 81
Park Ranger 82
Wildlife Biologist 83
Pesticides and Toxic Substances 87
Legislation 87
Employment 87
Occupations 88
Agricultural Chemicals Inspector 88
Agricultural Chemist 89
Agricultural Pest Control Specialist 89
Agricultural Services Biologist 90
Entomologist 91
Entomology Field Assistant 92

Environmental Epidemiologist 92
Hazardous Waste Management Specialist 93
Industrial Hygiene Chemist 93
Pest Control Helper 94
Pest Exterminator 95
Pesticide Control Inspector 95
Pesticide Use Medical Coordinator 96
Plant Physiologist 97
Registration Specialist (Agricultural Chemicals) 98
Toxicologist 99
Vector Control Assistant 100
Solid Waste Management 103
Legislation 103
Employment 103
Occupations 104
Refuse Collection Superintendent 104
Refuse Collection Supervisor 105
Refuse Collection Truck Operator 105
Resource Recovery Engineer 106
Sanitation Inspector 107
Waste Management Engineer 107
Waste Management Specialist 108
Radiation Control 111
Legislation 111
Employment 111
Occupations 112
Chemical Radiation Technician 112
Emergency Services Radiation Coordinator 113
Health Physicist 113
Radiation Laboratory Technician 115
Radiation Monitor 116
Radiation Protection Engineer 117
Radiation Protection Specialist 117
Radiological Instrument Technician 118
Other Environmental Activities 121
Occupations 121
Chemical-Laboratory Technician 121
Engineering Aide 123
Engineering Technician 123
Environmental Economist 124
Environmental Lawyer 125
Environmental Lobbyist 126
Industrial Hygiene Engineer 127
Industrial Hygienist 128
Industrial Waste Chemist 129
Laboratory Aide 130
Occupational Health Nurse 130
Physician 131
Federal Job Information Centers 135
Glossary 139
Bibliography 143
Appendix 1: Financial Assistance 149
U.S. Office of Education 150
National Science Foundation 152
U.S. Department of Energy 152

Other Sources of Information 152
Appendix 2: Postsecondary Environmental Education Programs, by Type of Pollution, by State 155
Appendix 3: The Environmental Protection Agency 193
Legislation 193
Research and Development Programs 196
Financial and Technical Assistance 197
Sharing Domestic Responsibilities 198
Sharing International Responsibilities 202
Index to Occupations 205

Introduction

Problems in Environmental Protection

In proportion to the earth's size, the layer of air that surrounds our globe is no thicker than the skin on an apple. A shallow crust on the earth's surface provides a limited supply of water and other resources. The tiny envelope of air and this shallow crust of earth and water are the biosphere—that part of our world that supports life. It is a closed system in which all things are recycled and reused in support of the life process.

Human beings are a part of this closed life system and depend on it for survival. Of all living things, however, they alone are capable of consciously cooperating with nature to insure their survival and progress.

Since the Industrial Revolution, the accelerating growth of science and applied technology has given us increased power and new tools to alter this planet as we choose. Our scientific discoveries and technological developments have enhanced life, but too little thought has been given to the second- or third-order consequences of our actions. As the following paragraphs will show, we have failed to anticipate that the environmental modifications accompanying our actions have a global impact on human health and welfare in both direct and indirect ways, as well as on generations to follow.

Wastewater

Our waters used to be clean. But industry and population growth have produced more and more industrial and human waste—more than Nature's own purification system can handle, and our waters are overloaded with impurities.

Thousands of industrial plants discharge billions of gallons of wastes into our waterways each day. Much of it is inadequately treated; some is not treated at all. Public sewer systems dump another 40 billion gallons of waste daily, including untreated sewage from more than 1,400 cities and towns and inadequately treated sewage from another 2,300 communities. An additional 50 billion gallons a day—most of it untreated—comes from agricultural sources including pesticides and fertilizers from farmlands as well as bacteria and chemicals from cattle and hog feedlots.

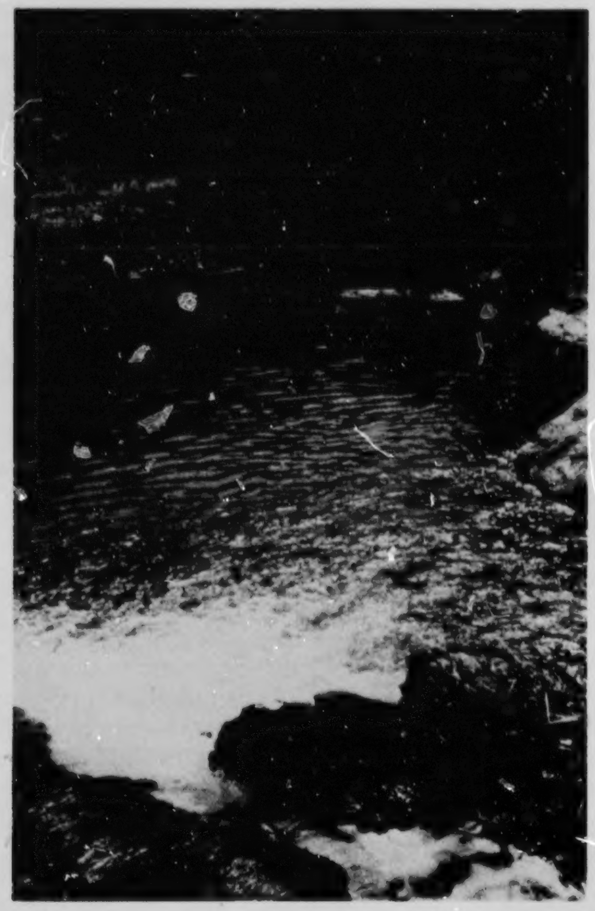
A huge volume of storm water drains into waterways every day, bringing with it tons of pollutants and eroded soil. More than 62 million tons of garbage, sludge, chemicals, explosives, debris, and dirt are dumped off our coast annually. About 8,500 accidental and deliberate oil spills contaminate our coastal and inland waters each year.

Water need not be dirty to be polluted. Power plants and many industries borrow some 130 billion gallons of water from our waterways each day for cooling purposes. When this heated water is returned to the body of water from which it has been taken, it can raise the average temperature by 20 to 60 degrees. Although the water remains clean, raising the temperature creates "thermal pollution." When the temperature of water increases, its chemical makeup changes and it loses its ability to hold oxygen. Animal life is threatened because, unfortunately, animals require more oxygen to survive as the temperature rises.

Thermal water pollution also affects reproductive behavior and alters the balance of marine populations. It increases the susceptibility of marine life to disease and causes increases in populations of bacteria and viruses.

Drinking Water

Besides damaging marine life, water pollution affects the source water from which drinking water must be processed. The quality of source water usually determines the treatment processes required to produce safe, acceptable drinking water. More than 50,000 community drinking water systems are in use in this country and more than 200,000 drinking water systems serve locations such as restaurants and motels. Many of these systems were designed, primarily, to remove from the relatively clear water of earlier days the types of bacteria found in animals and people and are not equipped to cope with the present water quality.



Beginning in 1970, the public drinking water systems in 13 states were studied. Many systems had not met bacteria standards 1 or more months during the 12-month period before the studies were made. Numerous systems also did not meet bacteria surveillance standards, and others needed either additional treatment facilities or important changes in their operation. In all 13 studies, major increases in State budgets were recommended for drinking water supervisory agencies to protect public health.

In 1978, an EPA survey of public drinking water supplies in 80 cities found that small quantities of organic chemicals were present in drinking water systems in all parts of the country. Although the survey found them in very low concentrations, their presence was cause for concern. Most conventional treatment plants, originally built to produce water from less polluted sources, may be ineffective in the removal of increasing amounts and varieties of these chemical contaminants, trace metals, and radioactive materials.

Because of deficiencies in the operation of drinking water treatment facilities and distribution systems, EPA investigators are also concerned about viruses in drinking water. Infectious hepatitis, for example, an illness of the liver, is caused by a virus that may find its way into drinking water.

Air

Most Americans are now familiar with air pollution alerts, and most are aware of the causes of air pollution. Automobiles and airplanes burn fuel and discharge millions of tons of pollution into the air every year. Factories, while producing goods for households and businesses, also pour poisonous smoke into the air. Power plants produce electricity, but the coal and oil they burn cause air pollution. We are able to buy more goods than ever before, but when we are finished with them we burn many of them and further pollute the air.

The air pollution settles on land and on buildings, making them dirty. It smells bad and stings our eyes. The health costs and damage to property are estimated in the billions of dollars every year. Scientists are convinced that air pollution is a very real contributing factor to the three major diseases that cause sickness and death in our society—heart disease, lung disease, and cancer.

Noise

Noise, a more subtle pollutant, usually leaves no visible evidence. An estimated 14.7 million Americans are exposed to on-the-job noise that threatens their hearing. Another 13.5 million of us are exposed, without knowing it, to dangerous noise levels from trucks, airplanes, motorcycles, hi-fi's, lawn mowers, and kitchen appliances.

Recent scientific evidence shows that relatively continuous exposure to sound exceeding 70 decibels—expressway traffic, for instance—can be harmful to hearing. More than that, noise can cause temporary stress reactions such as increasing heart rate, increases in blood pressure, high blood cholesterol levels, and digestive and respiratory ailments. As a result of persistent, unrelenting noise exposure, it is possible for these reactions to become chronic stress diseases like high blood pressure or ulcers.

Pesticides

Pesticides, like many other discoveries, have the capacity for great good or great harm, depending on how they are used. They have saved millions of lives through control of disease-carrying insects. They have minimized catastrophic crop damage from insects, weeds, plant diseases, rodents, and other pests; they have preserved valuable forest and parkland from insect destruction; and they have protected households against damaging beetles, moths, and other bugs. Used in plant regulators, they prevent premature dropping of fruit. In defoliants they stimulate uniform plant maturity so that mechanical harvesting can be used more effectively. Pesticides retard the growth of fungi in asphalt, paint, plastics, and jet fuel, and they are used in products that sterilize, disinfect, and sanitize.

On the other hand, certain pesticides, if not handled properly, present an immediate danger to the user. Some are highly toxic and may cause serious illness and even death if they are spilled on the skin, inhaled, or otherwise carelessly used.

Even more perilous are pesticides that persist in the environment over long periods of time and move up in the food chain. For example, small amounts of chemicals absorbed by plankton and insects are transferred in increasing concentrations to fish, birds, animals, and eventually to humans through food. These chemicals are retained in body fat and other tissues. There is no evidence that this concentration is harmful to humans. There is evidence, however, that concentrated pesticide residues act adversely on the reproduction and behavior of certain birds and may threaten the survival of some wildlife species.

Pesticides can be widely dispersed in the environment, mainly by the action of wind and water. The most significant concentrations are around the areas of intensive use, but traces have been found in the Antarctic and other areas far from the area of application.

Solid Waste

Each year U.S. households and commercial sources generate over 140 million tons of solid waste: bottles, cans, newspapers, deodorant containers, insect spray cans, gasoline rags, packaging material, and so forth. Although some of this waste is recovered for productive uses, most of it is disposed of in landfills, incinerators, and open dumps; is littered on city streets and country landscapes; or is carried out to sea and dumped. In addition, sewage sludge, demolition, waste, construction refuse, and recycled junked autos add to the municipal solid waste disposal burden. This does not even include runoff from mining and agricultural activities. Nor does it include waste from industrial processing activities.

Although consumers enjoy the benefits of industrial productivity, they also share the problems of disposal. Wastes that are deposited in open dumps breed rats and insects, and rains may wash chemicals from these dumps into streams. Wastes that are covered in a sanitary landfill may seep into a spring below and into a large river where they kill fish and wildlife. Those wastes that are burned cause air pollution.

The esthetic effects of open dump sites, uncollected trash, and littered streets are of general concern. Although these effects are not directly measurable in dollar terms, millions are spent annually for litter pickups. High rates of solid waste production also imply that we are digging deeply into our supply of natural resources such as fuels, minerals, and forests. This digging is a most significant source of environmental damage. Many persons have come to regard our high-waste, low-recycle system as inherently wasteful of our endowment of natural resources.

Hazardous wastes are the particularly dangerous discards of our highly industrialized society. Although they should be disposed of with special care, sometimes they are not. They can poison, burn, maim, blind, and kill people and other living organisms. They may snuff out life immediately when inhaled, swallowed, or brought into contact with the skin. Some are nondegradable and persist in nature indefinitely. Some may accumulate in living things. Some may work their way into the food chain.

Hazardous wastes are with us as solids, liquids, gases, and sludges. They may catch fire or explode when exposed to normal temperatures and pressures or when exposed to air or water. Some may be set off by an electrostatic charge, others by being dropped or jarred. Some are highly sensitive to heat and friction.

When simply dumped on the land, hazardous wastes may percolate or leach into groundwater and thus contaminate or poison water supplies. They may be carried by rain runoff directly into streams, rivers, lakes, and oceans. At some manufacturing plants, hazardous wastes are stored in open ponds or lagoons; these wastes can also create pollution problems. Hazardous wastes may pollute the air when incinerated; the residues from the incineration may themselves be hazardous and still require careful disposal.

Sanitary landfills, where wastes are covered with earth each day, are preferable to burning or open dumping. But unless specially designed, a sanitary landfill may still pollute water, and venting gas may pollute the air. Injecting hazardous wastes into deep wells can pollute groundwater.

Ocean dumping is a threat to marine life and the ecological balance of the seas, as well as to humans who come in contact with improperly sealed and weighted hazardous materials dropped into the oceans.

However—and this is the key to effective regulation—technology is available today to treat and safely dispose of most nonradioactive, hazardous wastes. What is needed is a general realization that business as usual in the disposal of hazardous wastes is just not good enough.

Radiation Control

Although no absolute evidence exists that adverse health effects are caused by low levels of radiation, EPA assumes that even the smallest amounts of radiation are potential causes of cancers or other health damage. Besides being open to natural radiation from the sun, humans are exposed to radiation from X-ray equipment, color television sets, luminous dial watches, microwave ovens, fallout from past testing of nuclear weapons in the earth's atmosphere, and radiation from jet flights.

The most controversial sources, however, are nuclear plants that use uranium as fuel to generate electricity. A sufficient supply of clean energy is essential if we are to sustain healthy economic growth and improve the quality of our national life. Utilities are turning to nuclear power stations to fill expanding needs: whereas there were 29 nuclear plants in operation in the United States in 1973, there will be 200 to 300 plants by 1985. Although they avoid many of the environmental problems of fossil-fueled plants, nuclear plants present their own potential hazards that must be controlled.

Safety problems in nuclear reactors will become more complicated as larger reactors are built. Moreover, the day-to-day operation of nuclear reactors results in radioactive waste. The serious problems of how the very hazardous, high-level wastes will be stored, reduced in volume, and finally disposed of has not been fully resolved.

Although most of the waste at present comes from the production of nuclear weapons and related research, the expanded construction of nuclear power reactors will further complicate the problem. High-level radioactive waste from expanding commercial nuclear power production is expected to grow to 4.5 million gallons by 1980 and to about 60 million gallons by the year 2,000, compared to 600,000 gallons in 1973.

Toxic Substances

In recent years toxic substances have become a major concern. Residues from chemical manufacturing products are all around us—in our air, our water, our food, and things we touch. Many of these chemicals have become essential to our lives. Synthetic fibers are used to replace human tissue and to create our easy-to-wear wardrobes. Plastics have been molded for use in almost every phase of our activities—in transportation, in communication, and in industrial and consumer goods industries. Our leisure time has been enhanced, for example, by durable, low-maintenance pleasure boats and other recreational equipment made from plastics.

Also, the chemical industry makes a significant contribution to the national economy, with sales representing more than 6 percent of our gross national product. Millions of workers are employed by the chemical industry or chemical-dependent industries.

Nevertheless, while we have enjoyed the extensive economic and social benefits of chemicals, we have not always realized the risks that may be associated with them. In recent years, many chemicals commonly used and widely dispersed have been found to present significant health and environmental dangers. Vinyl chloride, which is commonly used in plastics, has caused the deaths of workers who were exposed to it. Asbestos, used in flame retardants and insulation, has been known to cause cancer when inhaled. Mercury, another substance in everyday products, has caused debilitating effects in Japan.

Perhaps the most vivid example of the danger of uncontrolled contaminants is the family of chemicals called polychlorinated biphenyls (PCB's), which are used in such products as housing insulation, plastic food containers, etc. It was not until after tens of millions of pounds of PCB's were produced and released into the environment that scientists realized how toxic and persistent they were. Despite limited restrictions imposed by the industry in the early 1970's to reduce the production of PCB's and to restrict use of PCB's to electrical equipment where escape to the environment would be minimal, high levels of PCB's continue to persist in the Great Lakes and other major waters across the nation. Over the past few years, we have found PCB's in our bodies and in the milk of nursing mothers.

Recently some close relatives of PCB's, polybrominated biphenyls, or PBB's, have posed a similarly grave threat to human health and the environment. PBB's are used, for instance, as flame retardants in textiles and are used in making plastics. Accidental use of PBB's in animal feed led to the contamination of thousands of Michigan cattle, which had to be slaughtered. The health effects of PBB's on the Michigan farming families who were exposed to PBB's and consumed PBB-contaminated products are still uncertain.

By the late 1960's, lakes and waterways of our country had become choked with sewage, waste, and other forms of pollution. The air in urban centers was continually fouled with suspended dirt and poisons. The rate of lung ailments was increasing noticeably. Quantities of the residue of DDT and other pesticides were being discovered in tissue samples from wild life and even human beings. Empty cans, the carcasses of automobiles, and other forms of trash littered the landscape. Concern was being expressed about potential problems associated with the use of radioactive materials. Levels of noise from highways and airports were deafening.

Trends for the Future

The first steps toward achieving a cleaner environment and protecting human health have been fruitful. Americans are learning how to use modern technology for the service of civilization. A deeper respect is being developed for the nature of the biosphere. The belief that industry cannot endure the restrictions of environmental controls is being replaced by an awareness of industry's role in taking care of the environment.

Between 1970 and 1975, EPA took well over 6,000 enforcement actions against the violators of air, water, and pesticide laws. As a result of rigorous enforcement of the Clean Air Act amendments, current standards for auto-produced pollutants require reductions of automobile emissions. Regulatory actions leading to the diminished use of persistent pesticides, such as DDT, have reduced the detection of these pesticides in human tissues. By 1980, approximately 25 major American cities are to be involved in some form of resource recovery from municipal trash.

Federal standards are being established to protect citizens from unnecessary exposure to radiation. EPA has set noise standards for new heavy duty trucks and for portable air compressors. The agency is also developing regulations for new buses, loaders, motorcycles, garbage compactors, and truck refrigeration units.

Through the municipal construction grant program for wastewater treatment, the water discharge permit program, and the industrial water pollution control program, many of our rivers and lakes, such as Lake Erie, one of the most threatened waterways, are becoming cleaner.

The growing problems of ocean spills and ocean dumping have become matters of special concern. The Marine Protection, Research, and Sanctuaries Act authorized EPA to regulate ocean waste disposal, and accordingly the agency has carried out a permit program to limit the kinds and amounts of waste that can be dumped. The need for improved international cooperation to protect the oceans from oil and other pollution hazards is recognized, as demonstrated by the Ocean Dumping Convention adopted at London in 1972 and by the 1973 London Convention for the Prevention of Pollution from Ships.

Certainly EPA could not have begun the job on its own. The Agency has always emphasized that positive environmental action demands public participation. State and local governments, citizen organizations, and countless private individuals, many of whom have been working on pollution control for years, are working with the Agency.

The realization that we are part of an ecosystem that we must not destroy has forced us to ask ourselves some fundamental questions. Where and how do we want economic and urban growth? How can we best use and re-use our natural resources? How can we adjust our priorities to insure that we fulfill our energy, transportation, housing, recreation, and personal consumer needs without intensifying environmental problems? It is up to Americans to develop a new pattern of environmental management. We must become the first generation to work with nature instead of against her.

Environmental Careers

Before choosing careers in the environment, students should consider a few questions: What do they enjoy doing? What are they good at? How much education do they plan to get? How much can they spend on training? Having narrowed their goals a bit, students can start investigating the many different jobs that deal with the improvement of the environment.

Guidance counselors are a good source of further information on general and specific subjects. Many guidance departments keep files of job opportunities and a reference library to provide assistance.

There are many ways to find out more about careers in the environment. For information write to local, State, and Federal agencies and to special-interest national organizations. Watch for newspaper articles reporting current local efforts to deal with environmental problems. From these stories students can get ideas about future job needs in their communities and can learn the names of people in charge of operations. Some of these officials may be willing to discuss environmental careers.

There are many postsecondary schools that have training programs directly concerned with environmental work. Postsecondary schools—either traditional 2-year or 4-year colleges and universities or trade schools, technical institutes, vocational schools, or correspondence courses—are continually adding courses in environmental fields. After students have selected career fields and discussed them with counselors, parents, employment officers, persons established in careers, or other advisors, they should ask some basic questions about the postsecondary schools with environmental studies programs. Do graduates find jobs when they graduate? What specific courses are required, and what is the normal length of time for their completion? Who are the faculty?

Making sound evaluations of schools is especially important to students seeking environmental careers. Growing concern for the environment has resulted in increased competition.

Students seeking undergraduate degrees may prefer to major in traditional fields rather than concentrate on environmental studies. Federal, State and local government agencies often prefer to hire persons from traditional fields and train them for environmental applications. Also, students with such educational backgrounds are in a strong position to compete for jobs in nonenvironmental areas if they are unable to find employment in environmental fields. At present, engineering is a good example of a field in which employers often prefer to hire undergraduates from traditional educational backgrounds. Such students, if they wish, may specialize in environmental fields at the graduate level. Students selecting an undergraduate major should consider not only the degree of competition for environmental jobs, but also the possibility that they would want to change jobs in the future.

There are some environmental occupations, for example in the equipment operation and support groups, that are available for immediate entry with little or no previous training. For the most part, jobs in these areas are in local government systems under the public works department and are secured by contacting the city or county government personnel office or the respective civil service offices (usually listed in the telephone directory under city government or public works department).

Many State and local pollution control agencies conduct training programs on a regular basis for new-entry personnel who are beginning careers in environmental protection. Information regarding training may be obtained by contacting the appropriate State pollution control agency listed under the name of the State in the telephone directory. In addition to on-the-job training for new employees, these programs often upgrade training of those currently employed.

Persons may also get help from the local Job Service office of their State employment service. The State employment services are affiliated with the U.S. Employment Service of the U.S. Department of Labor's Employment and Training Administration and constitute a Federal-State partnership. At each of the almost 2,500 Job Service offices located across the United States, jobseekers are helped in finding employment, and employers are assisted in obtaining qualified workers.

Organization of Occupational Descriptions

Each individual career description in this book is listed under its preferred occupational title and has the same basic organization as the other career descriptions in order to help the reader in making comparisons.

☐ The opening section lists alternate titles by which the career is known and describes the major job duties of workers in that profession. Places of employment and areas of specialization within the field, if any, are discussed.

☐ The Job Requirements section gives information on the professional training required for the job, recommended paraprofessional education, any special skills or aptitudes necessary or helpful for successful job performance, state licensure, professional certification or registration, and other factors related to employment.

☐ The Opportunities section indicates the employment outlook for the occupation in the job market.[1] Opportunities for advancement are discussed and any additional qualifications needed.

Dictionary of Occupational Titles[2] code numbers are listed as well as other sources of information. An asterisk denotes new DOT title, post-1977 edition. No codes are shown for these.

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[1] As of 1979-80. It should be noted that the job market for any particular job may change, depending on current economic conditions nationwide and locally.

[2] *Dictionary of Occupational Titles*, 4th ed. (Washington: U.S. Department of Labor, Employment and Training Administration, 1977.) Available from the Government Printing Office.

Water and Wastewater

Water covers more than 70 percent of the Earth's surface. It fills the oceans, rivers, and lakes, and is in the ground and even in the air we breathe. However, 97 percent of the Earth's water is in the ocean and is too salty to drink. Add the amount of water in icecaps and glaciers and the percentage is over 99 percent. Thus less than 1 percent of all the water is in rivers, lakes, ponds, vegetation, water supply pipes, the atmosphere, and underground.[1]

The same amount of water exists today as existed when the world was formed. It is used and reused again and again. Water is merely borrowed for a time from the Earth's supply and then returned to it.

Although the global balance of water is constant and stable and the amount of water remains the same, the distribution of water is uneven. Some areas of the world are always too dry, and others too wet, experiencing extremes of drought or too abundant rainfall.

Since prehistoric time, people have taken fresh water from the surface of rivers and lakes and from wells that tap underground water. Until this century, the ancient principles of settling and filtering were usually sufficient for the treatment of water.

In the past, waste products dumped into our waterways could be properly treated by natural processes in those streams. Today, population growth and increased industrial activity have in many locations overloaded the capacity of our streams. Some pollutants can never be assimilated and as they persist and accumulate in nature they pose a continuing danger to public and ecological health.

There are several ways in which water pollution control can be accomplished: (1) through treatment of wastewater prior to discharging to a stream; (2) by the enactment and enforcement of government regulations prohibiting and limiting the discharge of pollutants to waters; and (3) the development of practices and techniques that prevent or limit natural runoff of pollutants.

Traditionally, the principal method of treating wastewater in the United States has been to collect wastewater in a system of sewers and transport it to a treatment plant where the water is treated before it is released into the streams and lakes.

Many older municipalities have combined sewer systems that carry water polluted by human use and storm water polluted as it drains off homes, streets, and land. During dry weather, all of it is carried to the treatment plant, but in a storm, sewers often carry more than the treatment plant can handle which means that part of the wastewater must bypass the treatment plant and flow directly into the streams. In areas lacking a sewer system or treatment plant, the individual homes use septic tanks.

At present, there are two basic stages in the treatment of wastewater: primary and secondary. In the primary stage of treatment, solids are allowed to settle and are removed from the water. The secondary stage uses biological processes to purify the wastewater even further. In some cases, the two stages may be combined into one basic operation.

In many cases, the basic wastewater treatments are not enough and additional advanced wastewater treatment is needed. Advanced, or tertiary, treatment processes take up where primary and secondary treatments leave off. A number of these advanced treatment processes are being used today. Other processes are under study.

Whenever wastewater is treated there is always something left over. This residue, or sludge, must also be disposed of. Some cities produce fertilizer from sludge. Some industries have found they can reclaim certain chemicals during treatment. Studies are underway to help solve the problem of what to do with sludge.

Legislation

Water pollution control began largely as a Federal activity. From the River and Harbor Act of 1899 through the Water Quality Act of 1965 and the Clean Water Restoration Act in 1966, the Federal Government established criteria for all interstate and coastal waters.

In the late 1960's, public concern about pollution became widespread. The Federal Government could not regulate pollution of intrastate waterways and could not take action against a polluter of interstate or navigable waters if the pollution occurred in only one State.

The Federal Water Pollution Control Act Amendments of 1972 brought dramatic changes. The law says, in essence, that no one—no city or town, no industry, no government agency, no individual—has the right to pollute our water.

To implement the law, a new national system of uniform controls on the discharge of pollutants was set in motion. Under this law, as amended by the Clean Water Act of 1977, it is illegal for any industry to discharge any pollutant without a permit. Industrial facilities that send their wastes to municipal treatment plants must meet certain minimum standards and insure that these wastes have been adequately pretreated so that they do not damage municipal treatment facilities. Municipal treatment plants must also meet discharge standards.

Federal standards for drinking water were first issued in 1914 to prevent the interstate spread of communicable diseases. Since then, they have been modified and expanded several times.

These standards also served as guidelines for most States and large cities in regulating the drinking water quality within their jurisdictions. In 1970, the EPA assumed responsibility for setting and enforcing these regulations.

The 1974 Safe Drinking Water Act, as amended in 1977, assured that water supply systems serving the public meet minimum national standards for protection of public health. The primary regulations established maximum allowable contaminants levels in drinking water. Secondary regulations were designed to protect public welfare, and deal with taste, odor, and appearance of drinking water.

The improvement of the quality of surface water makes it easier to provide safe drinking water. Surface water, however, will always require some treatment before it is used in drinking water. Approximately 50 percent of the Nation is served by drinking water from surface sources.

Employment

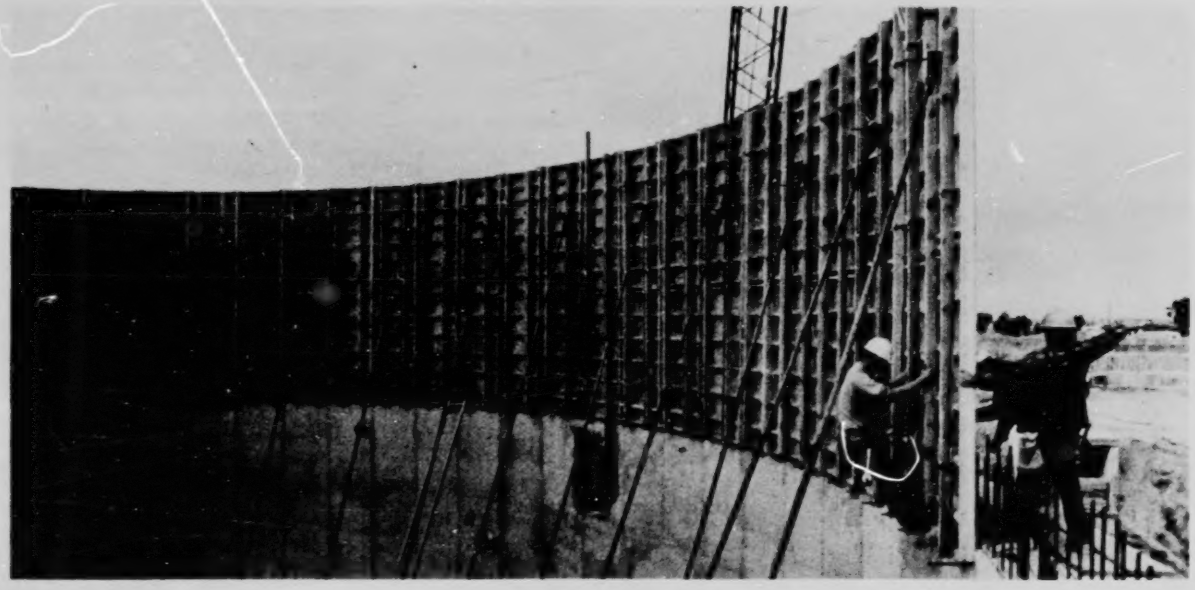
In the war on pollution, the wastewater treatment plant will continue to be the best weapon. This means a continued need for well-run, well-kept treatment plants and the personnel to operate them.

Jobs in water pollution control activities are expected to grow at least as fast as the economy. These jobs are usually steady and not as subject to economic downturns as those in manufacturing. An increasing number of women are finding employment in water pollution control work.

For minorities and youth who do not have professional or technical training, there are some occupations that require a high school diploma or less. These entry jobs can provide valuable experience for young workers and many employers help them continue their education at vocational-technical schools or junior colleges.

The greatest demand, however, will be for technicians, operators, and professionals. Jobs for the untrained and unskilled are limited in number and decreasing.

In the sections that follow, *water treatment* occupations are those occupations concerned with processing raw water so that it is safe for consumption by households, manufacturers, schools, and others. *Wastewater treatment* occupations, on the other hand, are those occupations concerned with treating water that has been used by consumers or collected from storm drainage systems and returning it to rivers and lakes.



Water Treatment Occupations

In order to insure a safe water supply, water is purified in treatment plants to remove chemical and biological impurities and to improve its appearance, taste, color, and odor.

In treating water, the waterworks supervisor plans and coordinates the activities of workers engaged in the operation and maintenance of the plant and the distribution of water to customers.

In a purification plant, water-treatment-plant operators control the machines and equipment to purify and clarify the water. The pump-station operator operates the pumping equipment to transfer raw water from the river or underground source to the treatment plant and again to distribute the purified water to customers. Treatment-plant mechanics repair and maintain the machinery and equipment. In larger plants, water-filter cleaners clean the filter beds.

To soften the water or make it suitable for drinking, chemists in the laboratory analyze water samples to determine the chemical dosages needed to destroy harmful organisms and to remove organic and inorganic compounds. Larger laboratories may supplement their staffs with technicians and possibly an aide.

After the water leaves the purification plant, it is carried through a distribution system of underground mains and pipes to customers. Meter readers are needed to read the water meters and record the consumption readings so that customers can be billed. Water plants also employ meter repairers to test and repair the water meters.

Chemist, Water Purification

The laboratory is a major guardian of the health of a community and the center of water quality control in a water treatment plant. Chemists analyze water samples throughout the treatment processes to control the chemical processes which soften it or make it suitable for drinking.

Chemists in purification or water treatment plants test water samples for bacteria which is the key to health problems, for esthetic quality or freedom from odor and taste, for turbidity or suspended solids, for chemical quality, and for other characteristics. They use highly sophisticated testing equipment such as infrared, ultraviolet, and visible spectrophotometers. They also test for pesticides and herbicides and the presence of radiation.

In addition to testing water samples, chemists determine the amounts of chlorine to be used to destroy the microbes and other harmful organisms. They determine the kind and amounts of other chemicals to remove minerals, acids, salts, and other organic and inorganic compounds from the water to clarify and soften it.

In analyzing and solving problems related to water purification, they frequently work with engineers, managers, biologists, other professionals, and citizen groups to find solutions to water treatment problems.

This work involves the application of the principles and techniques of analytical chemistry to determine the structure, composition, and nature of water. Analysis requires not only the subtle correlation of theory and experience but also a keen insight into the nature of interferences and problems associated with analyzing water.

Chemists are employed in most large water treatment plants which are usually located in more heavily populated areas. In smaller plants, the laboratory work may be done by an outside or private laboratory.

Usually performed in well-equipped laboratories, the work may require considerable standing. These chemists are expected to plan, organize, and carry out their assignments with a minimum of supervision. Other qualities important in this occupation are an inquisitive mind, initiative, and the ability to work independently. Good eyesight and eye-hand coordination are also essential to perform exacting, detailed, laboratory work.

Job Requirements

Most employers consider a bachelor's degree with a major in chemistry or a related discipline sufficient background for a beginning job as a chemist in a water treatment plant. A basic background in chemistry plus experience and skill in laboratory techniques provide a good foundation.

Required courses include analytical, organic, inorganic, and physical chemistry and preferably courses in mathematics and physics.

It usually takes a few months of on-the-job training under an experienced chemist to become familiar with the specific duties in the laboratory. Many laboratories require additional in-service training and orientation each year in new methods of analysis, chemical reactions, and other topics such as civil defense.

Opportunities

Opportunities for chemists in water treatment plants are expected to increase as new water treatment plants are constructed to meet the needs of the expanding population. For public water systems to meet increased regulation and water quality standards, additional laboratory personnel will also be needed. Other water analysts are employed by private industry and by regulatory and government agencies.

A chemist in this area could be an instructor in a junior or community college. A master's or Ph.D. degree is usually required for research or teaching in colleges or universities.

DOT code: Chemist, Water Purification 022.281-014

Meter Repairer

Water-meter repairers are skilled workers who test and repair watermeters. They test the meters to determine the cause of malfunctions, such as leaks or accuracy of recordings both under high- and low-pressure conditions. Simple maintenance and repairs are usually completed at the site. They include, for example, replacing glass, cleaning or replacing dials, replacing washers and packings, and other tasks. Large commercial meters must usually be repaired in the ground. Other meters are sometimes brought back to the meter repair shop where they are taken apart, cleaned, repaired, and tested before being reinstalled. Water-meter repairers also install new meters.

Some repairers work on all kinds of meters; others may specialize in one type of meter, such as the kind used in private homes. In larger plants, repairers may specialize in one aspect of the work, such as installing new meters or testing meters.

In this work the individual must be able to read land plots, job orders, location cards, and manuals for some assignments. Good manual dexterity is necessary to use handtools and operate the repair machinery and equipment. An ability to climb and stoop is necessary to repair the meters at the site. At times the worker may be exposed to wet, humid conditions. An interest in mechanical work also indicates success in this work. In many areas, repairers must also deal with complaints, so that tact and courtesy in public contacts are important.

Job Requirements

In some locations, employers consider an eighth grade education sufficient for this job; many employers, however, now require a high school diploma.

Some experience in the repair of small machines and mechanical devices is a good preparation for this kind of work, although experience is not usually required.

Trainees begin by working with an experienced repairer and learn the duties through on-the-job training, usually within 6 months to 1 year. In larger plants, they may begin as meter readers and then become meter installers, gaining good experience for repair work.

Opportunities

Automatic meter reading may become more common and, as technology improves, maintenance and service work could decrease in demand but be more complex. However, these maintenance and service jobs should continue to be available for many years and are not as subject as production work to fluctuations in the economy.

A repairer with additional experience could become a supervisor.

DOT code: Meter Repairer	710.281-034

Pump-Station Operator, Waterworks

Pumping-plant operator
Water-plant-pump operator

Raw water must be lifted or transferred from rivers or other ground sources to the water treatment plant by pumping. After the purified water leaves the plant it is never exposed to the open air and it may have to be lifted many times in its journey from the treatment plant to residential, commercial, and industrial users. Booster pump stations that increase pressure on the system are nearly always controlled from one point, from which pumps can be started or stopped and valves opened or closed by remote control. Some pump stations have automatic controls.

All components, pumps, storage tanks, conduits, and mains must work together to keep plenty of water, under controlled pressure, available at all times and under all conditions. As the load on the water systems varies, the pumps adjust the flow to meet the demand.

The pump-station operator operates and controls turbine or motor-driven pumps that transfer the water from reservoirs to the treatment plant and from the plant to homes, industries, and businesses. These operators read and interpret flowmeters and pressure and water level gages in order to regulate the equipment. They also inspect the equipment and perform routine maintenance work on the machinery to keep it operating efficiently. Careful records and logs must be kept of water output, utilization of equipment, and consumption of purchased or generated power.

In some plants, operators also conduct routine tests on raw and processed water. Some operators also operate hydroelectric equipment to generate power to supplement or supply energy to operate the pumping equipment. Or they may operate the treatment plant equipment at times (see Water-Treatment-Plant Operator).

This is light work requiring considerable walking and standing. The duties make good manual skills and coordination necessary to adjust and operate the pumping equipment. The operator works both outside and inside.

An indication of success in this work is an interest in working with tools and machinery and manual aptitude.

Job Requirements

The qualifications and training requirements for pump-station operator are generally the same as for water-treatment-plant operator. In many treatment plants, this worker may also be required to operate the treatment plant equipment on occasion. In plants where the operator operates only the pump station equipment, the training time would be sligntly less than for water-treatment-plant operator, or approximately 6 months. Certification is required.

Opportunities

In some plants, an operator might begin as a pumper helper or a maintenance worker and with 6 months or more experience in treatment plant operations, could be trained in these duties in several weeks.

A pump-station operator could advance to water-treatment-plant operator with approximately 6 months additional on-the-job training or vocational-technical school training.

Some openings should occur for pump-station operators in larger municipal water treatment plants as a result of normal attrition—transfers, promotions, and retirements.

DOT code: Pump-Station Operator, Waterworks 954.382-010

Supervisor, Waterworks

A waterworks system includes the water purification processes and the distribution network that carries water to the customer. Treatment plants vary widely in design, methods of operation, types of chemicals used, and other features. It is primarily the source of the water supply that determines the complexity of the plant and the chemical treatment. Very little of the distribution system shows above ground, but buried in the earth is a spider web of pipes and concrete.

The supervisor of a waterworks system plans and coordinates the activities of workers engaged in the operation and maintenance of the plant, other facilities, and the distribution system, which insures an adequate water supply for customers.

The supervisor assigns personnel to shifts to operate and maintain filtering and chemical treatment equipment, coagulating and settling basins, other plant facilities, and the distribution system. In the event of emergencies, such as machine, equipment, or power failure, or the need to release dammed water to effect flood control, the supervisor must decide what to do.

Another important responsibility of the supervisor is the preparation of plans and specifications for new equipment or the modification of existing equipment. The supervisor is always seeking to bring about the increased operational capacity or efficiency of the plant.

Other duties may include reviewing and evaluating various reports, preparing budget estimates for anticipated personnel and material needs, and other reports concerned with chemical bacteriological analyses of water. In some positions, the supervisor directs construction and maintenance of roads and communication lines used in operating the water supply system.

Supervision of a waterworks system is a round-the-clock operation and involves meticulous recordkeeping of locations of mains, valves, hydrants, connections, easements, properties, and permits; records are also kept on the treatment and purification of the water. The supervisor is responsible for the upkeep and maintenance of every item of equipment. It is this person who must locate problems, such as an outage (break), and have them repaired immediately.

Important supervisory qualities include leadership abilities, communication skills, and the ability to motivate workers and maintain good rapport with the public and employees. The supervisor must be able to demonstrate work methods or even help out in an emergency. Other indications of success include the willingness and ability to assume management responsibility, good work performance at lower level positions within the plant, and the ability to understand, interpret, and apply work procedures and regulations.

This is light physical work which requires some walking and standing to inspect the plant and observe the performance of employees. Work is performed both inside and outside the plant.

Job Requirements

Most employers require a bachelor's degree in civil, chemical, or sanitary engineering, science, or a related field. In addition, at least 2 to 3 years or more experience in water treatment plant operations and maintenance work are necessary. Specialized operator training courses can sometimes be substituted for formal education. Certification is a requirement.

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[1] *Water in Your Life* (University City, Mo.: St. Louis County Water Co., 1972), p. 2.

Opportunities

This position is usually filled by promotion from within the plant. A shift supervisor or foreman would need experience in all phases of waterworks system activities.

A supervisor of a waterworks system could advance to assistant superintendent or superintendent.

The number of supervisory positions is limited. Vacancies occur usually as a result of attrition caused by retirements or transfers. Competition for supervisory positions is keen and the most experienced and highly qualified workers have the best chance of obtaining these positions.

DOT code: Supervisor, Waterworks 184.167-246

Water-Filter Cleaner

Laborer, filter plant
Sand-cleaning-machine operator
Water-filterer helper

American cities began filtering their central water supplies around 1870. Today, filtering is still an important part of modern water treatment. In modern filter basins, the bottom of the filter looks like a waffle iron. At the bottom of each basin there are layers of graded gravel, sand, and even anthracite coal. The water is allowed to filter downward to the base of the filter basin leaving the last traces of suspended matter behind and the water comes out clean. These filter basins must be washed frequently.

The water-filter cleaner uses a suction pipe to transfer the sand and gravel from the filter bed onto regrading screens. The cleaner washes and simultaneously screens the sand and gravel to remove any foreign particles and to grade the material to size, by the use of a hose. The cleaner then reverses the water flow to remove chemical precipitates and impurities which are floated to the top. The worker must scrape and remove the dirt from the side of the filter bed, using a metal scraper. After cleaning, the worker reverses the action of the suction pipe and returns the sand and gravel to the filter bed.

In some water plants the cleaner, using a sand cleaning machine, also cleans and redistributes the sand. The cleaner may lubricate and repair the equipment.

Among the most important requirements of this job are the strength to perform heavy work and the ability and willingness to follow simple instructions.

The water-filter cleaner works both outside and inside the plant and is exposed to water and humidity in working around the filter basins.

Job Requirements

This is elemental work and requires no previous training. Most employers probably prefer someone with an eighth grade education, although less is sometimes sufficient.

A person can usually learn these duties in a few days of on-the-job training.

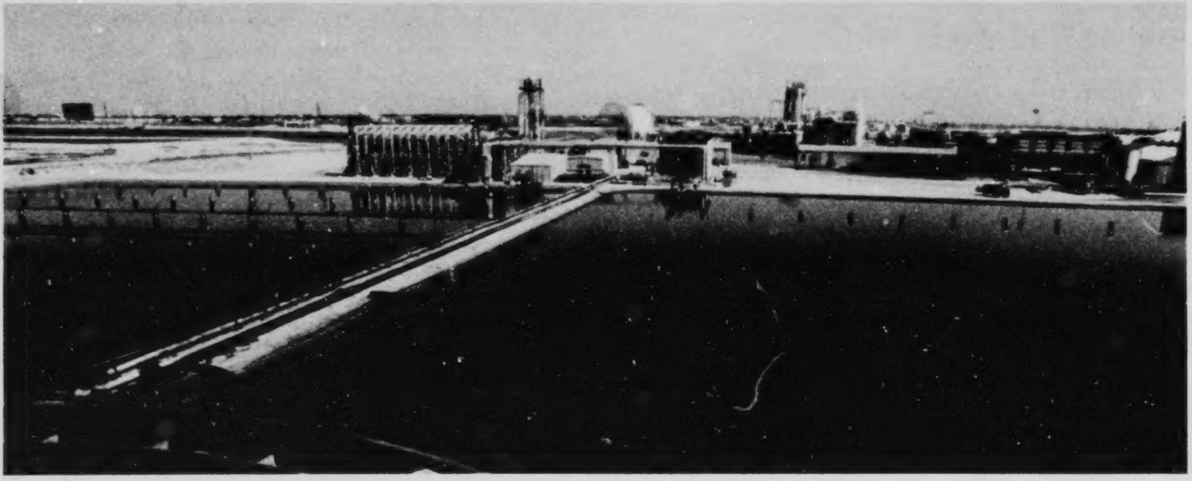
Because many workers will qualify for this work, personal traits like reliability, industry, and cooperation are especially important in selecting an individual.

Opportunities

Most of these jobs are located in large, municipal water treatment plants. In smaller treatment plants, this work may be performed by the water-treatment-plant operator.

Openings will usually result from the need to replace workers who have advanced to higher level work. In some plants, with additional education, a water-filter cleaner could perhaps become a trainee water-treatment-plant operator or a treatment plant mechanic helper.

DOT code: Water-Filter Cleaner 954.587-010



Water-Meter Reader

Water-meter readers read residential, commercial, and industrial water meters and record the water consumption readings so that customers can be billed. They check to see that the meters are working properly. Sometimes they must verify the accuracy of the readings or determine the reasons for abnormal or unusual consumption patterns by carefully checking information with office records. They must also look to see if the meters have been tampered with or changed. In some jobs, they may turn service off for nonpayment of charges in vacant residences, or may turn it on for new occupants.

Water-meter readers must maintain legible and accurate records in their route books or on account cards which are returned to the business office for billing purposes. They may complete other service forms when repairs are needed or other problems arise. Sometimes they collect delinquent or final bills when service is discontinued. Any work dealing with the public always demands courtesy and tact.

To be successful in this work, an individual must be able to make arithmetic computations rapidly and accurately, keep legible records, and follow both written and oral instructions. Some knowledge of the geography and street locations of the area and an ability to read maps are necessary. This work requires close attention to clerical details.

It is light physical work. One in this occupation must be able to climb steps to reach meters that are located in basements. Good vision is also important in reading the dials and numbers on the meters accurately. These workers are outdoors most of the time, even in inclement weather.

Job Requirements

Most employers ask for a high school diploma or equivalent as the minimum educational requirement, although in some cases less is acceptable.

Persons in this work are usually trained on the job in a few weeks. Some employers provide a few days in-plant training in the types of meters and account records the worker will use before the employee begins field work.

Opportunities

Openings for water-meter readers will occur through normal attrition as workers retire or transfer to other positions.

An increasing number of customers are using remote reading devices which enable the water-meter readers to obtain the necessary information from the basement-located meter without entering the house.

With additional training, a water-meter reader could become a meter installer or a meter repairer.

DOT code: Water-Meter Reader	209.567-010

Water-Treatment-Plant Operator

Filter operator
Purifying-plant operator
Water-control-station engineer
Water filterer
Water purifier

Most of us assume that the water we drink is safe. Certainly today's water treatment reflects increasingly higher standards in removing water pollution. Water-treatment-plant operators treat water so that it is pure and safe to drink.

In many locations, raw water is pumped from the rivers and streams to treatment plants. Operators control equipment to remove impurities and produce clear, drinkable water. They operate and maintain pumps, agitators, and valves that move the water through the various filtering, settling, and chemical treatment processes and through the distribution system.

Operators monitor the panelboards in order to adjust the controls to regulate water through the filter beds to remove impurities, flow rates, loss of pressure and water elevation, and distribution of water. Other tasks include operating and controlling pumps, agitators, and valves; operating chemical feeding devices; taking water samples; and testing and adjusting the level of chlorine in water. Operators add chemicals to the tanks to disinfect, deodorize, and clarify the water. They use wrenches, pliers, and handtools to adjust equipment and machinery.

The duties of an operator vary, depending upon the size of the plant and the types of treatment. For example, a water treatment plant in a large city probably involves a greater variety of treatment processes. In a treatment plant serving a small community, the operator is probably responsible for performing all duties within the plant—keeping records, maintenance, testing of water samples, and handling complaints, as well as operating all of the equipment and machinery. In larger plants, the staff usually includes mechanics, chemists, laboratory technicians, helpers, supervisors, and a superintendent.

In recent years, regulations concerning water purification treatment have become more stringent. In seeing that these requirements are met, the water-treatment-plant operator plays an important role.

There are more than 50,000 community water supply systems in this country and more than 200,000 water supply systems serving locations such as hotels and motels. Almost every community in the country has one or more water treatment plants. Some operators in small towns work only part-time or they may also be responsible for a wastewater treatment facility.

Considerable walking and standing are necessary to operate and maintain the treatment processes. The individual must be able to use handtools and adjust gages and controls on equipment. The operator works both inside and outside, sometimes in inclement weather and is frequently exposed to the hazards of water and machinery.

Job Requirements

Usually trainees must have a high school diploma or equivalent and some experience in the operation and maintenance of mechanical equipment. In larger plants they may begin as laborers or helpers. They begin by performing routine tasks such as taking water samples, simple maintaining and repairing of equipment and machinery, reading meters and charts, and keeping routine records.

Some positions are covered by civil service regulations and applicants must pass written examinations testing their knowledge and skill before they are considered eligible for employment.

Some community or junior colleges offer 2-year programs in environmental technology leading to an associate degree. These programs provide interdisciplinary, general education courses for a liberal arts background as well as technical courses in a specific field such as water pollution control. In most colleges one option is offered for operators of water and wastewater treatment plants. This program is designed to prepare the operator for certification exams in operation of water and wastewater treatment plants.

Technical and vocational schools also offer 1-year programs in water and wastewater treatment which prepare the operators for certification examinations.

The apprenticeship program for this occupation requires 6,000 hours or approximately 3 years on-the-job training and instruction. This provides the trainee with an increasing amount of responsibility. Under an apprenticeship program the trainee receives instruction in such duties as operating pumps and other equipment, regulating and observing flow dials, adding chemicals, sampling and testing water, reading gages, maintaining logs, and making repairs.

Operators are sometimes required to take in-service courses to satisfy upgrading requirements for license renewal; educational qualifications for operators are being raised to meet the increased demands of the job. Most States provide advanced training courses in water treatment plant operations and maintenance to introduce new technology and specialized skills.

Specialized technical training in water and wastewater treatment typically includes such courses as report writing, applied aquatic biology, water supply purification hydraulics, sanitary chemistry, codes and regulations of water and wastewater treatment, and basic courses in technical mathematics, physics, and drafting.

In most States the operator in charge must be certified. The trend is for all operators in charge of a facility to be certified. There are typically four classifications of certification based upon such factors as size of the plant, complex technologies, experience and education of the operator.

Opportunities

Employment of water-treatment-plant operators is expected to increase through the 1980's owing to the construction of new water treatment plants and expansion of existing plants. Operators who staff water treatment facilities will work with increasingly complex and sophisticated equipment which represents large financial investments.

Many operators now employed will be required to upgrade skills and qualifications in order to operate plants in accordance with current standards and to meet pollution control requirements.

This work is fairly steady and not generally subject, as some other occupations are, to economic downturns.

In larger plants, a water-treatment-plant operator could become a foreman, supervisor, or superintendent with additional experience and education. In smaller communities an operator could be in charge of the entire plant and perform the full range of duties.

DOT code: Water-Treatment-Plant Operator 954.382-014

Wastewater Treatment Occupations

Sewer systems carry used water to the wastewater treatment plant. Sewer maintenance workers are needed to maintain and repair the sewer lines. In some areas, photoinspection technicians and TV technicians conduct internal inspections of the sewer lines.

When the used water reaches the wastewater treatment plant it is cleaned through a series of tanks, screens, filters, and other treatment devices. The superintendent is responsible for the entire operation of the wastewater treatment plant. Within the plant, wastewater-treatment-plant operators operate and maintain power generating, grit removal, pump and blower, and sludge processing equipment. The operators also direct wastewater-treatment-plant attendants and sewage-disposal workers in the more routine operations and maintenance work. In most plants, treatment-plant mechanics maintain and repair the machinery and equipment.

Most treatment plant laboratories have a chemist or a microbiologist on the staff and larger plants also have laboratory technicians and possibly an aide.

Industrial waste samplers collect wastewater samples for analysis by laboratory personnel in order that major users of the plant pay their fair share of treatment costs. Industrial waste inspectors follow up on this information and investigate sources of pollution, inspect pretreatment facilities, and calculate the surcharge assessments.

Chemist, Wastewater Treatment

The chemist in a wastewater treatment plant analyzes samples of streams, raw and treated wastewater, sludge and other byproducts of the wastewater treatment process to determine the efficiency of the plant processes and to insure that plant effluents meet local, State, and Federal requirements. The chemist decides what tests are needed and develops workable testing procedures to obtain the information in a minimum amount of time.

The chemist conducts highly specialized and complex chemical, bacteriological, and physical analyses of wastewater and samples. Some of these samples are taken within the plant before, during, and following treatment. These chemists test samples taken from major users of the treatment plant in order to monitor and regulate waste discharges into the sewer and treatment systems and to make surcharge assessments.

Often the sample or test solution is a complex mixture of many compounds and elements and the identification of a specific element can require many hours of extensive separation work to remove interfering constituents. These procedures may involve many identification procedures and the use of sophisticated equipment.

Chemists may specialize in testing that requires special instruments such as the gas chromotograph, the atomic absorption spectrophotometer, or the infrared spectrophotometer. The chemist must be able to develop new techniques to use the equipment and also make adjustments and repairs on these complex electronic instruments.

Another important responsibility of the chemist is to identify problems in the wastewater treatment and to develop new procedures in the use of the equipment and the laboratory in order that they may be fully utilized.

Chemists also take part in special research and studies on plant operations and the treatment unit processes.

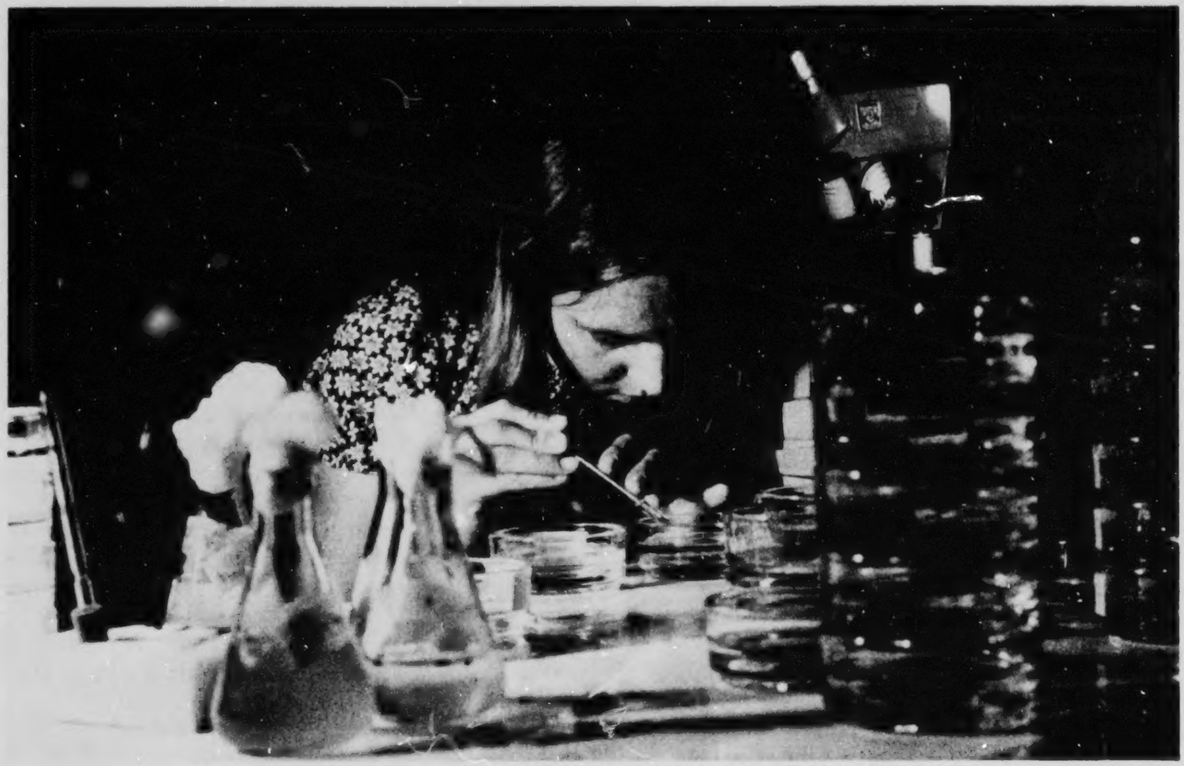
A chemist must be able to work independently and plan and organize the work efficiently. In most plants, the chemist also supervises one or more laboratory technicians.

Working in a laboratory may require standing for long periods and exposure to fumes, odors, and toxic substances.

Job Requirements

Most of these chemists have baccalaureate degrees with major work in chemistry, biochemistry, or a closely related field. Some employers also require 2 years of laboratory experience or an equivalent combination of experience and training. In some laboratories, additional course work in instrumentation is needed to operate the specialized equipment.

In smaller laboratories, high school gradution plus college-level courses in chemistry, biology, and bacteriology might be accepted as the minimum educational background.



In addition to the academic preparation, the chemist needs a thorough knowledge of the treatment processes and the pertinent local, State, and Federal requirements and regulations. This knowledge is usually obtained on the job.

Certification is not always required. However, in larger plants chemists are encouraged to become certified and it is usually a requirement for advancement. With certification, a chemist could advance to the position of assistant superintendent or superintendent of a treatment plant.

Opportunities

Federal legislation requires that local governments control water pollution and safeguard public health and welfare. It is anticipated that chmists will continue to be in demand to analyze wastewater samples and insure that treatment processes and effluents meet current government requirements. Recent legislation requiring users to pay their fair share of the cost of wastewater treatment has increased monitoring of commercial and industrial establishments to see that they do not exceed the effluent limitations established. Increased sampling requirements have placed greater demands on laboratories to analyze these samples.

DOT code: Chemist, Wastewater Treatment*

Industrial Waste Inspector

The industrial waste inspector inspects industrial and commercial waste treatment and disposal facilities and investigates sources of pollutants in municipal sewage and storm drainage systems.

The inspector visits establishments to determine if they have industrial waste permits and to enforce provisions of the permits. These inspections usually include checking the equipment used by the establishments in pretreatment of the wastewater, such as floor drains, settling and neutralizing tanks, clarifiers, and grit and grease traps, to insure that they conform with municipal ordinances.

By automobile or boat, the inspector also conducts surveys of rivers, streams, and water in adjacent areas to determine the effects on wastewater discharges.

Inspectors collect samples of wastewater from sewers, storm drains, and water courses and return them to the laboratory for analysis. In some cases, field tests are conducted at the site for such data as acidity, alkalinity, chlorine, and hydrogen sulfide to determine if discharged wastes will cause deterioration of sewage facilities or pollution of the water.

Inspectors work with industrial officials, the public, and supervisors and give advice on pollution problems and methods of pretreatment. They also investigate complaints of odors, gasoline leakage, oil, or other problems to determine their cause and identify responsibility.

Since 1972, effluent limitations have been set up for nearly all major industrial discharges in the Nation. In most areas, industries are required to monitor their own discharges from specific sources. In order that industry pay its share of treatment costs, municipalities have adopted a surcharge system used for the major contributing industries.

The inspector may be required to maintain detailed records on assigned industries for calculation of surcharge assessments. In order to determine these charges, the inspector analyzes laboratory reports or wastewater samples and compares this data with industry declared information and the legal requirements.

The inspector must be able to establish good rapport with the public and representatives of commercial and industrial establishments.

An inspector should be capable of performing light physical work and, at times, might be required to climb ladders, steps, or reach awkwardly located sampling sites. Good manual skills are also important in order to work with testing and sampling equipment.

Inspectors work both inside and outside, sometimes in inclement weather. They usually work alone, although occassionally they may direct technicians or surveillance teams in sample collection. On field trips, inspectors are sometimes exposed to unpleasant fumes and odors. Inspectors do not usually work shifts.

Job Requirements

An inspector must have a good knowledge of wastewater treatment plant operations, routine field tests, legal requirements, sewer collection systems, and the maintenance and operation of treatment equipment and machinery.

One or 2 years experience as a wastewater-treatment-plant operator will provide a good background for this work because this position is usually filled by promotion within the plant. A driver's license is also required.

Opportunities

Industrial waste inspectors are needed to enforce industrial waste discharge ordinances. Most of these jobs are located near large metropolitan areas or wherever large industries are concentrated.

It is expected that regulatory and enforcement requirements will become more stringent in order to achieve clean water and at the same time provide for a fair distribution of treatment costs.

An inspector, with additional experience, education, and certification in wastewater treatment plant operations could possibly advance to a supervisory or managerial position.

DOT code: Inspector, Industrial Waste 168.267-054

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* Not listed in the 1977 edition of DOT.

Industrial Waste Sampler

Sample gatherer
Sampler

Industrial waste samplers take "grab" samples from streams and raw and treated wastewater for analysis by laboratory technicians and chemists in a wastewater treatment plant. They travel to the site and note any unusual features such as the presence of oil, discoloration of waters, sludge, and rate of flow. They dip buckets or other vessels to transfer samples from pipelines, tanks, or other places into test tubes, bottles, or other containers. The samples are labeled with identifying information such as the location of the sample and the time collected and delivered to the laboratory. This information is then used to determine any ordinance violations and, in order that industry pay its fair share of treatment costs, to calculate assessment charges for industrial users of the wastewater treatment plant.

Tests and investigations are also conducted at the site. These are usually routine procedures to determine certain characteristics of the wastewater such as acidity, alkalinity, temperature, turbidity, or other information. For some assignments, they also set up portable automatic monitoring equipment that takes samples at designated intervals and measures the volume or flow of the effluent.

Good eye-hand coordination, finger and hand dexterity, and the ability to detect visually unusual characteristics in wastewater samples and the surrounding area are needed.

Collecting samples may require some climbing, balancing, and stooping so that the person should be in good physical condition; light physical work is entailed.

This work requires driving a motor vehicle or even operating a small boat at times. The worker may be exposed to unpleasant odors and fumes.

Job Requirements

Persons can qualify for this work through several combinations of education and experience. Most employers prefer some specialized technical training at a vocational or technical school. Graduates of water and wastewater treatment courses also qualify.

In some plants, one can qualify for this work through on-the-job training. Working with an experienced worker as a member of a surveillance team, an individual could learn the job in a few months.

This occupation does not usually require working shifts.

Opportunities

The demand for samplers is limited; some openings will occur, however, as a result of attrition caused by promotions, transfers, and other factors.

In most cases, certification as well as completion of a formal training program in treatment plant operations is required for a sampler to advance to the position of wastewater-treatment-plant operator.

There has been some increase in the number of industrial wastewater samplers as a result of pollution control requirements. Wastewater treatment districts must monitor the effluents of industrial and commercial establishments because treatment costs are expensive and major users of the plant must pay their fair share of these costs.

DOT code: Laboratory-Sample Carrier 922.687-054

Laboratory Technician, Wastewater Treatment

The laboratory technician in a wastewater treatment plant performs routine chemical, biochemical, and physical analyses of samples taken from streams, raw and treated wastewater, sludge and other byproducts of the sewage treatment process, in order to monitor the characteristics of the wastewater and to measure how efficiently the treatment processes are working.

The technician collects the samples before, during, and following treatment and takes them to the laboratory for analysis. For routine tests, the technician sets up, adjusts, and operates the laboratory equipment and instrumentation such as microscopes, centrifuges, balances, scales, ovens, and other equipment in order to analyze the samples. The technician may assist the chemist in performing more difficult tests which use sophisticated equipment such as the infrared, ultraviolet, visible, and atomic absorption spectrophotometers; the gas chromatograph; and the total carbon analyzer.

In some areas, laboratory technicians also analyze samples of wastewater before it enters the collection system of the treatment plant. This is increasingly important to meet local and Federal pollution control requirements and to be sure that industry pays its fair share of treatment costs.

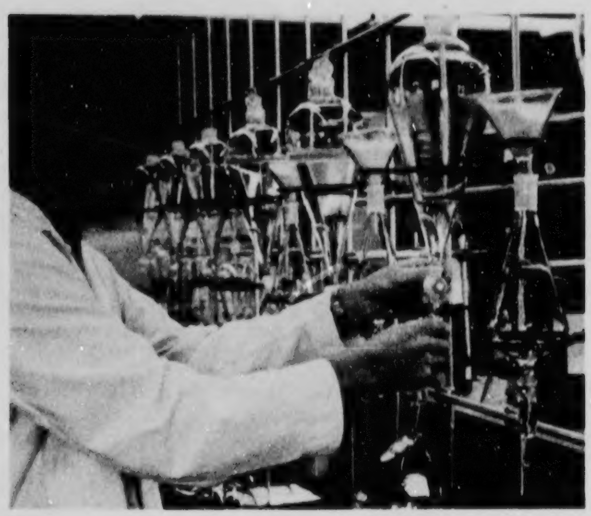
Today, technicians perform a variety of quantitative and qualitative analyses on wastewater for such characteristics as color, turbidity, pH, alkalinity, hardness, nitrogen, oxygen demand, chlorine residual, and other information. They also prepare the media and set up the equipment for other bacteriological tests to be performed by the chemist or microbiologist.

Careful, accurate records of test results are important to make precise determinations. An interest in and ability to do detailed exacting work are a must. Technicians must also be able to work well with other plant personnel; they often work under the close supervision of a chemist.

Technicians may be required to stand for long periods of time in the laboratory and are sometimes subject to unpleasant odors, fumes, and toxic and potential disease-producing substances.

Job Requirements

There are a number of community colleges that offer 2-year programs in pollution abatement control. A typical such program includes instruction in wastewater unit processes and waste management, as well as biology, chemistry, English, mathematics, and physics. A plant practicum is sometimes required, which gives the student additional training in program-related employment. This program prepares a student to perform all necessary analytical tests, both bacteriological and chemical, which are employed in a wastewater plant. With this training, the student receives an associate arts degree which could later be applied toward a bachelor's degree. This training also prepares the student for field work including inspections and collecting samples, or even responsibility for a complete wastewater treatment plant, or for some limited portion of the treatment.



Most employers consider graduation from high school, supplemented by 2 years of college-level courses in chemistry or the biological sciences, a good background for working in a treatment plant laboratory. In some cases, a portion of the educational requirement may be met with an equivalent combination of training and experience. On the other hand, it is not unusual for someone with a baccalaureate degree in chemistry or biology to work as a technician.

The technician should have a good knowledge of the unit processes used in the plant, industrial waste characterization and quantity evaluation, theory and techniques of qualitative and quantitative environmental chemistry, and instrumentation and analytical techniques. He/she should have practical experience in modern laboratory methods and techniques, and skill in the proper use of the various kinds of laboratory equipment.

Opportunities

The anticipated growth of new treatment plants and expansion of existing facilities should mean a continued need for laboratory technicians.

With additional education, a laboratory technician could become a chemist or move into a supervisory position. This laboratory experience would also be helpful for employment in other laboratories with local and Federal regulatory agencies or in private industry.

There will probably be some openings for laboratory technicians to staff new plants, and to replace technicians lost through normal attrition.

DOT code: Laboratory Tester 029.261-010

Microbiologist

Bacteriologist

Bacteriological testing is the key to health protection. Microbiologists, or bacteriologists, take bacteria counts on water samples, sludges, and sewage in controlling water pollution. They isolate and make laboratory cultures of significant bacteria and other micro-organisms from samples and then examine them through a high powered microscope. These micro-organisms can be harmful and must be identified in order to control the treatment processes.

At the end of the treatment processes, the finished waters or effluent must be safe. When there are unusual findings, the microbiologist must conduct laboratory research to find out why. Bacteriological testing is a critical part of controlling the treatment processes in both water purification and wastewater treatment.

Microbiologists maintain precise records of test results. They also prepare reports and other studies concerning the quality of treated water or wastewater for regulatory and supervisory government agencies.

Microbiologists work with chemists, operators, and other plant personnel in controlling treatment processes. For example, they work with chemists in determining the correct chemical treatment.

In order to succeed in this work, a person must have an inquisitive mind and a good imagination and be able to absorb and interpret scientific theories and data.

This work is performed in a laboratory. It is light physical work which may require standing for long periods. Finger and manual dexterity as well as good motor coordination are important to carry out the complex testing procedures and work with laboratory equipment. Normal vision and good color perception are required to identify characteristics of the cultures by the use of microscopes and other equipment.

Job Requirements

A bachelor's degree with a major in microbiology is usually the required background for entrance into this work. Some course work in chemistry is also required. In some positions, experience in laboratory work may also be required.

For a microbiologist working in a public health agency, registration or eligibility for registration as a medical technologist by the American Society of Clinical Pathologists may be accepted in lieu of college graduation. Sometimes, experience as a public health laboratory technician or comparable experience in a public health or medical laboratory may be substituted in part for deficiencies in the college requirement.

A person in this work must be able to apply basic principles of microbiology and laboratory techniques in order to solve problems related to water purification and wastewater treatment.

Opportunities

Microbiologists work in water and wastewater treatment plants, health departments, hospitals, medical laboratories, and regulatory agencies. Others are engaged in research or teaching activities at the college or university level or they work in private industry.

With experience, a microbiologist could become a supervisor or head of a laboratory. Graduate degrees are usually required for applied research and teaching positions.

DOT code: Microbiologist 041.061-058

Photo-Inspection Technician, Wastewater Collection

The photo-inspection technician operates a 35-mm camera to conduct internal inspections of sewer lines in order to determine the condition of the pipes and the need for repairs. The technician, using a map, determines the location of the section to be photographed and directs the sewer maintenance workers in the setting up of the cable stand over the manhole.

The technician photographs a TV monitor and a small blackboard giving the location of the manhole, manhole number, date, and type of weather for future reference. The camera is attached to the cable and the maintenance workers turn the cable stand handles so that the camera can move inside the pipe. As the camera moves along, pictures are taken at designated intervals until the camera reaches the downstream manhole.

The technician is responsible for efficient and safe use of the equipment and must train the other workers in proper work methods to insure that proper procedures and safety precautions are followed. Usually the technician drives the truck and hauls the crew and equipment to the site; therefore, a driver's license is necessary.

This work requires medium physical strength and involves climbing, stooping, and kneeling, and working with the hands in order to set up and operate the equipment to inspect the lines. Good hearing and vision are important.

The photo-inspection technician directs the work of other members of the inspection crew, usually consisting of a maintenance worker and a laborer.

This work is performed outside and involves contact with water and sewage, and exposure to weather, noxious smells, and gases. There is also some risk of bodily injury.

Job Requirements

The minimum requirement is usually completion of eighth grade, although graduation from high school or vocational school is highly desirable.

The technician must have a knowledge of sewer inspection, maintenance, and repair; of the operation and servicing of photo equipment; and of work hazards and safety precautions.

In addition, 2 to 3 years experience in the inspection, maintenance, and repair of sewerage systems are usually required for a worker to be fully trained in this work.

Opportunities

This job is typically found in communities where the sewer system serves a population of 100,000 and has 500 miles of sanitary main lines.

In many areas, this is an entry level position. From this position, an individual could transfer laterally to other maintenance work or, with additional experience, could advance to maintenance supervisor.

DOT code: Photo-Inspection Technician, Wastewater Collection*

Sewage-Disposal Worker

For a wastewater treatment plant to operate efficiently, the equipment must be kept clean and well maintained. The sewage-disposal worker cleans the equipment in the plant to facilitate the flow and treatment of the wastewater. For example, when wastewater enters the plant for treatment it flows through a screen to remove large objects such as rags and sticks. The person in this job must clean the accumulated debris from the screen using a rake or shovel.

The sewage-disposal worker cleans various filters, screens, processing tanks, and walkways using hoses, brushes, and chemical solutions. Pumps, grit chambers, and catch basins must also be kept clear of precipitates such as grit, sludge, trash, and muck.

This worker also lubricates the equipment including pipes and valves to keep them working smoothly, and opens and closes gates according to gage readings or warning lights on the equipment. Sometimes the worker collects samples of wastewater and wastewater byproducts for testing by the laboratory personnel.

The sewage-disposal worker works outside most of the time around the wastewater treatment areas and is often exposed to unpleasant odors. The work requires being close to machinery and water and that can be hazardous. In some plants, this worker also maintains the grounds and cuts grass, trims shrubs, and rakes leaves.

The most important requirement of this work is that a person be willing to perform routine tasks and possess the physical stamina and capacity to do heavy work. Coordination and manual skills are also necessary to handle the tools and maintain the equipment.

Because many persons can qualify for work of this nature, a good record of dependability and industry are especially valuable.

Job Requirements

Completion of eighth grade is usually required and some employers may prefer some high school. No previous experience is required in most cases, although experience in janitorial work or related tasks might indicate to the employer an inclination toward this type of work.

These workers usually are trained by other wastewater-treatment-plant personnel on the job. The duties can probably be learned in approximately 1 month or less.

Opportunities

Working in this capacity gives the employer an opportunity to observe your work performance and for you to demonstrate your dependability and industriousness.

After 1 or 2 years work experience in a treatment plant, a sewage-disposal worker could perhaps become a wastewater-treatment-plant attendant and be assigned to tend some of the equipment under supervision of an operator.

There should be a continued need for these workers both to staff new treatment plants and to fill vacancies created by attrition in existing plants.

DOT code: Sewage-Disposal Worker	955.687-010

Sewer Maintenance Worker

To maintain an efficient wastewater collection system, sewer lines must be inspected, cleaned, opened, and repaired. Other structures such as manholes must be checked, patched, cleaned, their walls raised, and their covers repaired. Most cities contract out the construction of new sanitary and storm sewers.

In larger communities, separate crews may be assigned to cleaning and repair work. For example, cleaning crews keep the lines clear of obstructions, handle emergency cases, and follow a scheduled preventive maintenance program. The repair crews repair and construct small sections of sewer lines, manholes, street inlets, and catch basins. In smaller communities, one crew would probably perform both functions.

Maintenance workers perform a variety of duties. First, all lines must be routinely inspected and kept clear of obstructions. These workers inspect manholes to determine the location of problems and clear the lines of obstructions such as roots, grease, sticks, and other deposits. They may use a mirror to reflect the sunlight into the sewer to check on the condition of the line, or they may advance a camera through the line, using a cable, in order to photograph the condition of the pipe and determine if repairs are needed. They also clean and repair the catch basins, manholes, culverts, and storm drains, using hand and power tools.

Periodically, sanitary and storm sewer sections must be replaced with new sections. Maintenance workers must measure the distance of the excavation site and mark the outline of the area to be trenched. They may use an air-hammer, pick, and shovel to remove broken or damaged pipe from the ditch and replace it with new pipe sections. The fittings must be tight and sealed properly before back-filling the section.

A higher level maintenance worker performs such tasks as directing lower level maintenance workers and laborers, maintaining various records of work completed, operating cleaning equipment, and ensuring that proper procedures and safety precautions are followed.

These workers either operate or assist in the operation of sewer cleaning equipment such as a power rodder, high velocity water jet, sewer flusher, bucket machine, wayne ball, and vac-all. They may also clean and disinfect domestic basements that have been flooded as a result of sewer stoppages.

This is very heavy work at the entry level. Debris accumulated in sewers must be removed and hauled away. Workers cut trees, shrubs, and brush, using a chain saw or an ax. They use a variety of hand and power tools in performing these duties. Sometimes they climb into manholes to determine the condition of the line. Maintenance workers must be in very good physical condition and able to climb, stoop, kneel, crouch, and crawl in order to reach work areas. They work with their hands most of the time and must have good vision and hearing.

This work is performed outside and involves exposure to weather, water, noise, noxious smells, gases, and the risk of bodily injury.

To perform this work, a person must be able to apply common sense in order to carry out detailed but uninvolved written or oral instructions. It is important to possess at least average aptitude in working with your hands.

Job Requirements

The minimum educational requirement is usually eighth grade for entry into this work. However, high school or vocational school is desirable.

Approximately 6 months on-the-job training is needed to learn this work. A maintenance worker must have a basic knowledge of the uses of sewer construction and maintenance tools and equipment and the hazards and safety precautions associated with this work. A driver's license is usually required.

Opportunities

This position may be filled through promotion of a laborer or applicants from the general public. With experience, a person could advance to higher level maintenance work such as a lead worker and have limited supervisory responsibilities. An experienced maintenance worker could become a maintenance equipment operator or construction equipment operator.

The Federal Water Pollution Control Act Amendments of 1972, as amended by the Clean Water Act of 1977, imposed stringent requirements for reliable wastewater collection operation and maintenance. There should be continued need for these jobs.

DOT code:	Pipe Layer	869.664-014
	Pipe-Line Worker	869.664-014
	Sewer Maintenance Worker	869.664-014

Superintendent, Wastewater-Treatment-Plant

The superintendent is responsible for the administration, operation, and maintenance of the entire wastewater treatment plant. The superintendent has direct authority over all plant functions and personnel. This includes analyzing and evaluating both operation and maintenance work; initiating or recommending new or improved practices and procedures; and recommending plant improvements, such as new equipment or construction.

The superintendent also prepares or reviews and approves operation reports and budget requests; prepares specifications for major equipment and material purchases; and is responsible for budgeted funds.

Success in this work demands the ability to maintain harmonious working relationships and to communicate effectively with plant employees, government officials, and the general public. The superintendent should be someone who can apply principles of logic to define problems, collect and analyze data, and draw conclusions. This requires interpreting a wide variety of technical instructions in books, manuals, diagrams, and mathematical form.

Except for regular plant inspection trips, this work is sedentary and is largely performed inside. The superintendent is occasionally exposed to weather, fumes, odors, dust, and risk of bodily injury when inspecting the plant.

Job Requirements

Most employers prefer that the superintendent have a college degree in sanitary, civil, chemical, or mechanical engineering. The minimum formal education is a high school diploma or equivalent, plus 5 to 7 years practical experience in treatment plant operations, depending upon the size and complexity of the plant. The minimum education would be characteristic of smaller, conventional wastewater plants.

Superintendents must have completed the operator training course or equivalent experience. Certification and at least 1 year of supervisory experience are required.

The superintendent must have a good knowledge of the processes and equipment involved in wastewater treatment, including basic hydraulics, structural analysis, and chemical, bacteriological, and biological processes; managerial, administrative, and accounting practices and procedures; and industrial wastes and their effects on the treatment processes and equipment.

Opportunities

This position is usually filled by promotion within the plant by the assistant superintendent, operations supervisor, or chief chemist, depending upon plant size and complexity.

With experience, a superintendent could accept a similar position in a larger or more complex plant. A limited number of openings should occur as a result of normal attrition. Only the best trained and most qualified persons, however, would be considered for this position.

DOT code: Superintendent, Sewage-Treatment 188.167-098

Supervisory Wastewater-Treatment-Plant Operator

Sewage plant supervisor

The supervisor of a wastewater treatment plant is responsible for the safe and efficient operation of the plant. This person directs the activities of workers who operate and maintain power generating, grit removal, pump and blower, and sludge processing equipment. The supervisor also directs the sample collection and testing of the wastewater in order to evaluate the effectiveness of the treatment processes. The supervisor then makes adjustments in the plant processes based upon laboratory analyses and insures that treatment processes meet the required standards.

Another supervisory responsibility is to inspect plant equipment such as pumps, sedimentation and aeration tanks, filters, comminutors, and blowers to detect malfunctions and insure that proper preventive maintenance is being performed. Repairs are discussed with the engineering staff and then the supervisor directs the workers in the repair and maintenance of the equipment. Outside engineers and mechanics may be brought in to direct major equipment changes and overhauls.

Wastewater treatment plants include a wide variety of specialized mechanical and electrical equipment plus buildings, structures, and grounds. Other maintenance responsibilities include supervising installations and testing of new or rebuilt equipment and determining the necessity for and establishing long-range maintenance programs. Other supervisory duties include preparing work schedules and budgets, training employees, and maintaining records and reports.

To be successful in this work the individual must be good at planning and directing the activities of other workers and be able to communicate effectively with them concerning very technical work. In maintenance work, the supervisor needs above average aptitudes in motor coordination, finger and manual dexterity, and eye-hand-foot coordination in order to demonstrate and instruct workers in maintenance.

This work requires solving practical problems and interpreting an extensive variety of technical instructions in books, manuals, and mathematical or diagrammatic form. Basic arithmetic, algebra, and geometry are also important.

This is light work, requiring walking and standing. An individual in this work, however, should be in good physical condition because duties may require climbing, stooping, kneeling, crouching, and crawling to reach equipment and to work along with subordinates on difficult aspects of the job. Most work is performed inside. There is risk of bodily injury in working around machinery and also exposure to unpleasant odors and fumes.

Job Requirements

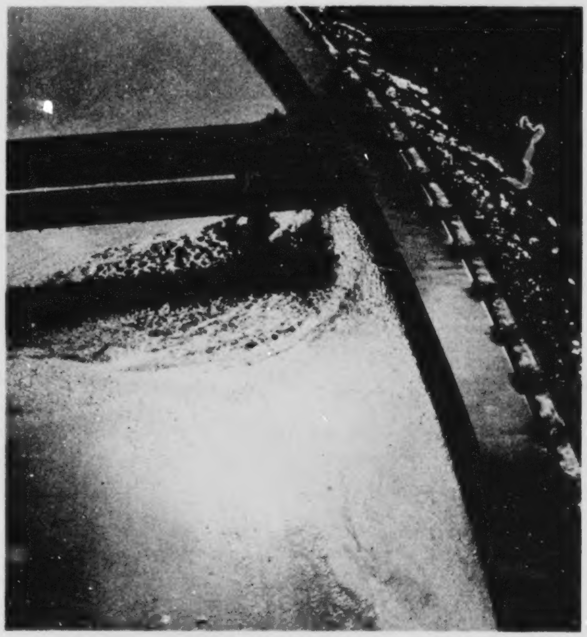
A high school diploma or equivalent is required and college-level courses in engineering and chemistry are highly desirable. Some grade school training is especially valuable in supervising maintenance work.

In order to qualify as a supervisor, an individual must have completed the operator training course (See Wastewater-Treatment-Plant Operator) or have some equivalent combination of experience and training. Certification is required to supervise operation of a plant.

Two to 4 years of experience in plant operations are usually required for supervision of operation activities, depending upon the education of the individual and the size and complexity of the plant. The supervisor must have a thorough knowledge of all aspects of the work supervised and be able to demonstrate technical "know how."

Opportunities

Today, the average wastewater plant is not highly automated. However, automation will be more prevalent in the future, possibly reducing the manpower required to operate treatment facilities but, conversely, requiring more technical maintenance manpower. Maintenance requirements depend principally upon the amount and kind of mechanical equipment installed.



Typically, plants treating less than 100 mgd (million gallons per day) have one supervisor who is responsible for both operations and maintenance; in larger plants, these functions and responsibilities may be divided between two supervisors.

In the war against pollution, the wastewater treatment plant is our best weapon. This means we will continue to need well-run, well-kept treatment plants to clean our water and that they must be well operated and maintained. Problems of inadequate operation and maintenance must be solved with well-trained personnel. A limited number of supervisory positions are available for the most qualified.

DOT code: Supervisory Wastewater-Treatment-Plant Operator 955.130-010

Treatment-Plant Mechanic

Filtration-plant mechanic
Water-treatment-plant mechanic

Most of us would not think of buying a new car and then driving it without periodic tuneups, oil changes, and lubrications by trained mechanics. All of us have a large investment in our local treatment plants; to protect that investment we need trained mechanics.

Treatment-plant mechanics maintain and repair the machines and equipment used to process and distribute water for human consumption and industrial use. Other treatment-plant mechanics work in wastewater treatment plants where used water is cleaned before it is returned to our streams and rivers.

Treatment-plant mechanics work in both water and wastewater treatment plants. They dismantle, or partially dismantle, equipment and machinery such as electric motors, turbines, pumps, hydraulic valves, chlorinators, limers, meters, gages, conveyors, and blowers to gain access, remove faulty parts, and make repairs.

Treatment-plant mechanics inspect the machines and equipment periodically, and perform preventive maintenance work, such as lubricating moving parts and replacing worn parts to prevent breakdown.

In some plants, these mechanics supervise lower grade mechanics, helpers, or laborers in maintenance work and repairs. They may also be required to operate the plant equipment at times.

Persons in this work must be able to visualize the parts and relationships of machinery and equipment from blueprints, diagrams, and manuals. They must have above average aptitudes in eye-hand coordination and manual and finger dexterity to work with hand and power tools such as wrenches, screwdrivers, and hoists. An interest in mechanical and craftwork is another indication of success.

Treatment-plant mechanics work both inside and outside, sometimes in inclement weather. They frequently must work alone with little contact with other workers. They must work around water where conditions are humid and even hazardous. In wastewater plants mechanics are exposed to unpleasant odors and fumes.

These mechanics must be strong enough to carry tools, parts, and equipment and to perform tasks requiring medium physical strength. Their duties can require considerable climbing, balancing, stooping, kneeling, and crouching, sometimes in awkward positions, in order to reach machinery and equipment.

Job Requirements

Many employers prefer high school or trade school graduates. Courses in mathematics, drafting, and industrial arts are a good background for this work.

Some trainees learn their skills on the job, under an experienced mechanic. Others attend vocational or technical schools or even take courses at a correspondence school. In any case, vocational training usually takes at least 1 or probably 2 years of specialized training.

Employers sometimes prefer to hire persons with 1 year or more of experience in some phase of mechanical repair.

Apprenticeship programs are available in some areas. Under such a program, the employee receives formal instruction along with on-the-job training.

Opportunities

Employment in maintenance and repair work is expected to increase faster than other occupations in the economy. This work is usually steady and not subject to economic downturns.

With experience, a mechanic could become a supervisor. Having additional education and experience and certification in plant operations, a treatment-plant mechanic could become an assistant superintendent or superintendent of a water treatment plant or a wastewater treatment plant.

Some mechanics are self-employed and provide maintenance services to private and other small treatment plants.

DOT code: Treatment-Plant Mechanic 630.281-038

TV Technician, Wastewater Collection

Knowledge of the condition of a sewer system is essential in carrying out an effective maintenance and repair program. This is accomplished by many means, but one of the most modern and effective is a television inspection and repair program.

In this program, a closed circuit television system is used for remote visual inspection of sewer lines. A TV camera is drawn through the line and a TV monitor shows the condition of the sewer. Even greater efficiency is accomplished when TV surveillance is used in conjunction with a telegrout system for the internal sealing of leaking sewer lines. The sewer sealing equipment is used with a television camera for remote internal repair of leaking sewer lines. The equipment is pulled through the pipe, its packer is inflated, and a chemical group compound is pumped over the suspected leak to seal the line.

The TV technician operates the mobile closed circuit television and chemical sealing units to conduct the internal inspection of sewer lines and to seal defective lines for the prevention of water infiltration.

The TV technician prepares inspection reports and records all pertinent data including the exact location of the defect. When serious or unusual irregularities are located, the technician photographs the television screen picture using a special camera.

In this work, a person must read and interpret maps, blueprints, schematics, and plans to locate defects and make repairs. The technician uses handtools to service, adjust, and make minor repairs to equipment and attachments.

Good communication skills and the ability to lead a small work crew and make on-site decisions concerning repairs are other requirements of this work. A valid driver's license is necessary to drive the specially equipped truck.

This is light physical work involving climbing, stooping, kneeling, and crouching. Work is with the hands much of the time so that manual and finger dexterity are important.

This is outside work and involves wet conditions and exposure to weather, noxious smells, and gases.

Job Requirements

A trainee could begin as a TV technician performing lower level tasks under the direction of an experienced TV technician. For these lower level duties, an eighth grade education is usually sufficient, although completion of tenth grade or vocational school is highly desirable. With this background, an additional on-the-job training of approximately 6 months would be necessary to learn to assist an experienced technician. Some of these duties would include measuring and mixing the compounds, setting up audio communication equipment, and performing other tasks.

To be a TV technician in charge of an inspection and repair team would require graduation from high school or vocational school. In addition, a minimum of 4 years experience in the field of sewer maintenance, including 1 year in an electronic-related field is needed.

This work requires a knowledge of sewer inspection, maintenance, and repair; a knowledge of the operation and maintenance of a closed circuit TV system and a chemical sealing unit; and a knowledge of work hazards and applicable safety precautions.

Opportunities

This can be an entry level position or is sometimes filled by promotion of a laborer working in the wastewater collection system. From TV technician an individual could advance to supervisory work.

Improvements in techniques of internal pipe inspection should continue. In the future, the TV camera will be coupled with cleaning tools so that the operators can see what needs to be done.

This position is usually found where wastewater collection systems serve populations of over 150,000. Typically, a TV grout team consists of two TV technicians (the team leader and an assistant) and two sewer maintenance workers.

DOT code: TV Technician, Collection System*

Wastewater-Treatment-Plant Attendant

Sewage-plant attendant

Wastewater-treatment-plant attendants tend pumps, conveyors, blowers, chlorinators, filters, and other equipment used to decontaminate wastewater by settling, aeration, and sludge digestion.

Attendants perform a variety of tasks. For example, they remove obstructions and coarse material from the bar screen as the influent enters the plant. They adjust pipe valves to regulate the flow velocity through settling tanks to separate sludge by sedimentation. They turn on air and steam valves to aerate the effluent and to control the temperature in sludge digestion. In larger plants, the attendant may be assigned to one station or processing unit within the plant such as the grit station, activated sludge, pump-and-blower, sludge-control, or sludge filtration processing units. The job is sometimes referred to as the processing unit.

Wastewater treatment equipment is an expensive investment and it is important that the attendant keep a close eye on temperature gages to determine if lubrication is needed. They must be able to read charts, flowmeters, and gages to detect equipment malfunctions and notify the operator in charge. Under close supervision, attendants also collect samples for laboratory analysis and perform routine tests, complete process reports, and make minor repairs on equipment.

In many plants, attendants are also responsible for a variety of cleaning and custodial duties. They do routine cleaning and maintenance work both inside and outside the plant. Using hoses, brushes, chemicals, and detergents, they scrub processing tanks, walkways, and other equipment. They may even cut grass, rake leaves, or shovel snow, especially in plants with a small staff.

The attendant must have good common sense and the ability to carry out both written and oral instructions, maintain routine records, and read charts, flowmeters, and gages. Recordkeeping involves some counting and recording of data. Motor coordination along with manual and finger dexterity should be at least average to perform these duties. The work is often repetitious and routine and the worker usually has little contact with other people.

Medium physical strength is required. Duties also necessitate climbing, balancing, stooping, kneeling, crouching, or crawling to reach work areas.

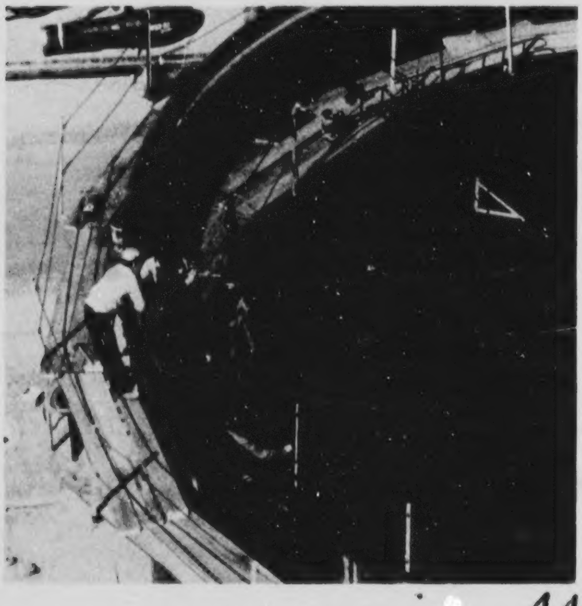
Much of the time the attendant works outside with no protection from the weather. Working close to water and machinery is hazardous. The worker is also exposed to unpleasant fumes and odors.

Job Requirements

Employers usually prefer that attendants have completed 2 years of high school and demonstrated some interest and ability in mechanical work. In most plants, the workers are trained on the job under an experienced operator. The training time ranges from 3 to 6 months, depending upon the size of the plant, the treatment processes involved, and the ability of the individual.

Opportunities

To advance to the position of operator, the attendant would be expected to complete high school or the equivalent. In addition, an individual would need at least 2 years experience in the operation and maintenance of plant equipment or some equivalent combination of training and experience, and be able to meet certification requirements.



The construction of additional treatment plants and improvement of existing plants should mean a continued need for attendants. This work is usually steady and not as subject to downturns in the economy as jobs in manufacturing and other fields.

DOT code: Wastewater-Treatment-Plant Attendant	955.585-010

Wastewater-Treatment-Plant Operator

Disposal-plant operator
Utilities operator
Sewage-plant operator

Wastewater-treatment-plant operators are responsible for the operation of equipment that cleans water before it is released into the streams or reused. It is no push-button job. The health and safety of the community depends upon the careful performance of the operator's duties; errors could have grave consequences, such as damaging expensive equipment or, even more serious, endangering the environmental health of the community.

Operators control and operate the pumps, pipes, and valves that connect the collection system to the treatment plant. They monitor control panels and adjust valves and gates manually or by remote control to regulate the flow of wastewater and waste solids through the plant. When the power flow or water flow change, operators assess the situation, find out what the causes are, and take appropriate steps to remedy the problem. They start and stop pumps, engines, and generators to control the flow of chemicals, wastewater, and solids through the various unit processes.

In some plants, operators operate and maintain power generating equipment to provide heat and electricity for the plant. Some treatment plants also have incinerator equipment and a variety of automotive equipment.

Wastewater treatment plants are expensive investments involving millions of dollars. Operators inspect motors, bearings, and gear boxes for overheating and proper lubrication, check the temperatures on digester heaters, and perform routine preventive maintenance on equipment. They regularly inspect the plant and equipment for malfunctions and needed repairs.

In larger plants, the staff might include chemists, laboratory technicians, maintenance mechanics, attendants, laborers, and office personnel. In these plants, an operator may be assigned to one unit process or one station and be known as an activated-sludge operator, grit-removal operator, pump-and-blower operator, sludge-control operator, or sludge-filtration operator.

In smaller plants, operators may be responsible for maintenance, buildings, grounds, routine laboratory tests, custodial work, handling complaints, and a variety of paper work—the complete operation of the plant.

Operators usually work shifts and could be called to work overtime during an emergency. At times they are exposed to inclement weather, fumes, odors, dust, and toxic conditions. Operators must use safety equipment in their work.

Persons interested in this work should have medium strength and be able to climb, balance, stoop, kneel, and crouch in order to work around plant machinery and equipment. Average motor coordination, finger dexterity, and manual dexterity are also important in using a variety of gages, wrenches, handtools, and special tools. Good communication skills are needed to maintain records and reports, interpret technical manuals, blueprints, and specifications, and to deal effectively with the public, supervisors, and coworkers.

Job Requirements

Persons interested in this field usually enter through on-the-job training programs, vocational or technical school programs, or a junior college curriculum in environmental technology.

Most employers require that trainees possess a high school diploma or equivalent. Employers also prefer that trainees have up to 2 years experience in the operation and maintenance of mechanical equipment and machinery or some combination of training and experience. Some positions, especially in larger communities, are also covered by civil service regulations and applicants may be required to pass written examinations to be eligible for employment. A solid foundation in mathematics is especially valuable.

In some areas, apprenticeship programs are available. Under such programs the individual receives formal classroom instruction in subjects such as mathematics, physics, chemistry, and communications. Classwork is combined with an increasing amount of on-the-job training under an experienced operator. Up to 3 years may be necessary to become a skilled operator. The training covers all phases of wastewater treatment operations.

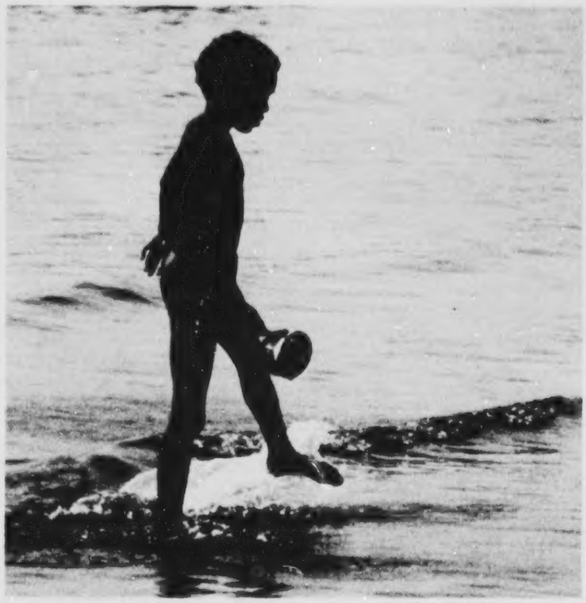
Vocational or technical schools provide intensive training in wastewater treatment. Many of these schools give up to 50 weeks of training in water and wastewater treatment operations. At the completion of the course, graduates are eligible for a journeyman license.

Scores of junior or community colleges offer a 2-year career curriculum in environmental technology, leading to an associate degree in applied science. A water and wastewater treatment option typically includes courses in humanities, social sciences, mathematics, science, general drafting, environmental technology, report writing, applied aquatic biology, plane surveying, hydraulics and pneumatics, water supply purification, wastewater treatment, sanitary chemistry, and other related subjects. This 2-year curriculum can also serve as a basic transfer program to a baccalaureate degree in environmental science.

The increases in investments in wastewater treatment facilities and advanced treatment developments have sharply raised requirements for skilled operators. In order to satisfy the up-grading necessary for license renewal, operators must sometimes complete special short courses.

In most States, operators are required to pass a written examination to certify that they are qualified to operate a plant. The trend is to demand certification of all career personnel whose actions or decisions can affect the quality of finished water or plant effluent. At present, however, certification is mandatory only for the operators in charge of a shift or plant operations; other operators are encouraged to obtain certification.

The programs typically have four different classes of certification for different sizes and types of treatment plants. For example, a Class I Operator capable of operating a small plant might be required to be a high school graduate, pass a written test, and complete 1 year of employment. A Class IV Operator might need 2 years or more of college in wastewater treatment and science or engineering technology, have 5 years experience in a large plant, pass a written test, and have a good knowledge of the entire field.



Opportunities

Most wastewater treatment plants are located where the people are—in the cities. Operators work for city and State treatment plants or for State environmental health agencies. One out of five operators work in private industry and one out of 20 in Federal installations.

Under the construction grant program, more and larger treatment plants are being constructed. Under the Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977, municipalities must provide secondary treatment for their plants; this should mean jobs for operators. It is expected that there will be a continued need for trained operators to fill positions and replace workers lost by turnover.

An operator could advance to senior operator or shift supervisor and be responsible for all processes during a given shift and supervise several journeymen and trainees. To advance to operations supervisor the individual would probably need at least 6 years of progressively responsible experience in both the maintenance and the operation of a sewage treatment plant.

DOT code: Wastewater-Treatment-Plant Operator 955.362-010

Water-and-Sewer Systems Supervisor

Water-maintenance supervisor
Water-service supervisor
Water supervisor

Water-and-sewer systems supervisors plan and coordinate the activities of workers engaged in installing, maintaining, repairing, and servicing water distribution and sewage facilities. This work includes excavating and backfilling trenches and culverts, installing, repairing, and replacing water and sewer mains, joining and calking pipelines, repairing valves and hydrants, drilling and installing taps in mains, and performing related street repairs.

The distribution of water and the collection of wastewater require a giant underground network of mains and pipes. These must be continuously maintained and extended as the population expands. It is necessary to maintain detailed records and refer to land plots, maps, and other diagrams in order to locate mains, valves, hydrants, connections, and other information.

These supervisors requisition materials and equipment such as pipes, special fittings and unions, cranes, drag lines, air compressors, and welders. They inspect work both in progress and upon its completion to insure that it meets specifications.

A supervisor must be able to plan and organize work projects and maintain good working relationships with employees. Leadership qualities are most important in directing the work of others. The supervisor must be experienced and skilled in the work he/she is supervising and have a thorough knowledge of safety practices and procedures connected with the work.

This work requires medium physical strength because the supervisor occasionally assists in the work. Good speech and hearing are needed to direct the workers. Good vision is also important in inspecting the work and observing the performance of workers. The work is usually outside.

Job Requirements

This position is most often filled through promotion. Although a high school education is preferred, less than that may be accepted by some employers. Completion of trade or vocational courses in mechanical skills, mathematics, or shop would be especially valuable. In many places, however, these skills can be learned on the job; 2 to 4 years experience in lower level maintenance and repair work is required.

Opportunities

Jobs in maintenance and repair of water and sewer lines should continue to increase with the growing population and new construction. Supervisory positions are limited and there is keen competition among qualified applicants.

With additional experience and education, a supervisor could take a position in a larger municipality or district or, within the same district, he could become superintendent.

DOT code: Water-and-Sewer-Systems Supervisor 862.137-018

Irrigation Occupations

Water is distributed to agricultural lands through irrigation systems. In some areas, reservoirs provide water for irrigating lands and crops. A water control supervisor is usually responsible for the allocation, regulation, and delivery of government controlled water.

There are a number of key jobs related to the delivery of water to agricultural lands. Basin operators tend and maintain desilting basins that remove silt from the river water before it enters the irrigation system. Watershed tenders control the equipment to regulate the water flow through the aqueducts and floodgates, allowing the water to flow by gravity to the areas below. Ditch riders regulate the waterflow into the canals and individual supply ditches for irrigation of the land.

Basin Operator

When river water enters an irrigation system, before it can be distributed to water users it must have the silt and sand removed. To do this, basin operators tend and maintain desilting basins.

These workers read dials and gages to determine if the equipment is operating properly, inspect sluice hoppers of clarifiers to detect clogged valves, and flush the valves to clean them. They are responsible for inspecting and repairing ventilating blowers, pumps, and corrosion system.

Other duties include maintaining simple records of equipment and repairs made, removing trash from the slots of the influent channels, and washing sand and silt from the ends of the channels, using a high-pressure hose. Workers patrol the dam area and compound to guard against fire, trespassing, or property damage.

Persons in this occupation must be able to adapt to routine and repetitive work and like working with machinery and equipment. Medium physical strength is required and the ability to climb, stoop, kneel, crouch, or even crawl in order to maintain and clean the machinery and equipment. Manual and finger dexterity are needed to handle rakes, hoses, and handtools.

This work is performed outside around water where conditions are wet, humid, and hazardous.

Job Requirements

Most employers prefer someone with a high school diploma although less than that is probably sufficient for entry into this work. Machine shop courses in high school would be valuable training. Employers often prefer applicants who have some employment experience in machine work.

This job can usually be learned through on-the-job training within 3 to 6 months.

Opportunities

Irrigation of agricultural land is crucial in many parts of the country, particularly in the West. There should continue to be a limited number of jobs available for many years.

Experience gained in this job would be valuable in other types of work, including maintenance and operations.

DOT code: Basin Operator 954.385-010

Ditch Rider

Canal tender
Ditch tender
Water tender
Zanjero

In all civilizations dams for flood control and canals for irrigation preceded other water distribution systems within towns and cities. Today irrigation systems insure an adequate, reliable water supply to farmlands in many parts of the country.

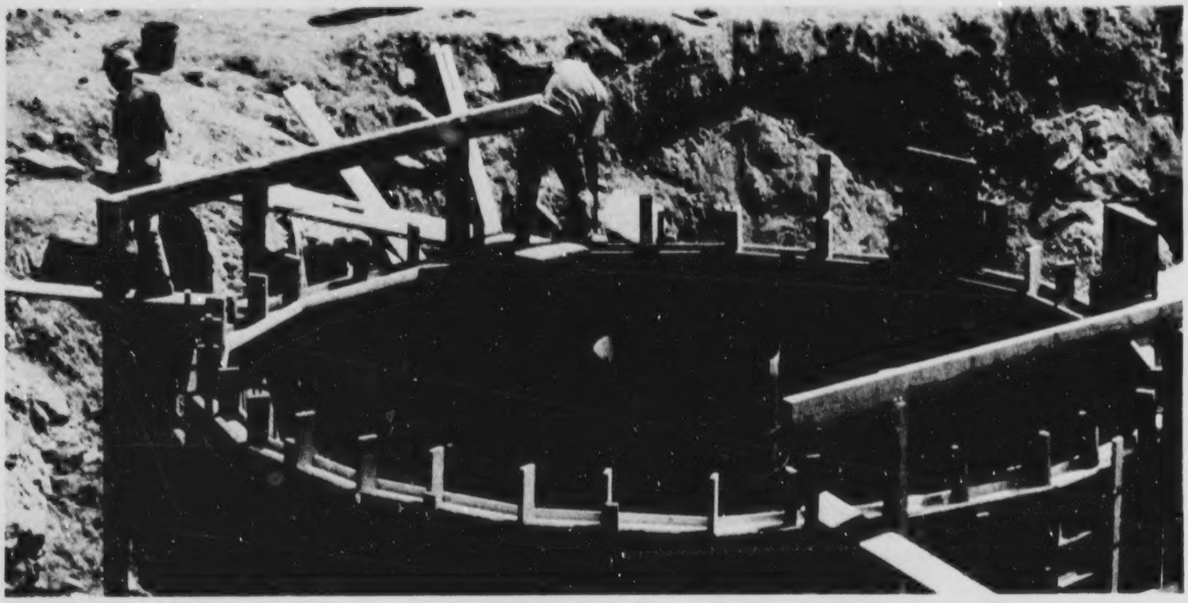
Ditch riders control irrigation systems to convey water to farms in assigned areas, according to rights, or as instructed by the water control supervisor or other officials, for irrigating fields and crops.

Ditch riders contact water users to determine the quantity of water needed and the time and duration of delivery. They operate the gages, checks, turnouts, and wasteways to regulate waterflow into canals and individual supply ditches.

Maintaining accurate records is an important part of this work. For example, ditch riders compute and requisition the quantity of water requested. They measure or estimate the diversions of water from the canals to the water users and calculate and record the quantities of water used.

Other duties include patrolling the area by foot, horseback, or motor vehicle to detect leaks, breaks, weak areas, or obstructions or damage to the system; removing debris and making emergency repairs to banks, structures, gages, and canal roads; filling holes and exterminating rodents.

After the irrigation season has passed, ditch riders spend most of their time cleaning ditches, raising ditch banks,



repairing concrete and wooden structures, erecting fences and gates, and other maintenance work. Some ditch riders supervise cleaning or maintenance crews.

This work requires medium physical strength. Stooping, kneeling, and crouching are often necessary to perform maintenance and repair work on the irrigation system. Good manual skills and coordination are also important to operate and maintain the equipment. This work, performed outside and around water, can be hazardous.

Job Requirements

Employers probably prefer persons having an eighth grade education although less than that may be acceptable. These workers must be able to apply common sense in carrying out instructions. Basic mathematics is needed in order to compute the quantities of water used and maintain records.

Usually, no previous training is required and a new worker can probably learn this job with 3 to 6 months of on-the-job training.

Opportunities

These jobs are located in agricultural areas, especially in the West and Southwest. Irrigation systems are more feasible in regions with a long or year-round growing season.

There will probably be a limited number of openings for ditch riders as workers retire or transfer.

DOT code: Ditch Rider 954.362-010

Water Control Supervisor

The basic duty of the water control supervisor is to distribute water to farmlands and crops. As a supervisor, this person directs and coordinates the activities of workers engaged in the allocation, regulation, and delivery of government controlled water and in the repair and maintenance of the facilities in an irrigation district.

Another important part of this job is to review the water rights agreements, irrigation contracts, and departmental policies and regulations to determine an equitable distribution of the water. The supervisor also schedules the time and amount of water to be distributed to the users.

The water control supervisor inspects the channels, siphons, tunnels, weirs, roads, bridges, buildings, and equipment for repair and maintenance.

Maintaining customer relations is another important part of this job. The supervisor confers with water users and investigates and resolves complaints and public relations problems. The supervisor must notify water users of changes in policies and procedures.

A person in this job must be able to plan and organize work assignments and to interpret and apply a variety of procedures and regulations. Clerical skills are also needed to maintain water control records.

Other important traits include the ability to motivate and direct other workers and to communicate effectively as well as a willingness to assume responsibility.

Job Requirements

The water control supervisor is usually someone who is thoroughly experienced in all phases of the work supervised and who has demonstrated the ability to plan and organize the work and maintain harmony in the working relationships.

In most cases, high school graduation is the minimum educational requirement. Some technical or vocational training is especially valuable.

Opportunities

There should be a limited number of openings as a result of attrition. These positions are usually filled through promotion of an experienced worker within the same facility.

DOT code: Water Control Supervisor 184.167-270

Watershed Tender

A reservoir is an artificial lake where water is collected and kept until it is needed. Reservoirs may serve agriculture and provide city water supplies as well. They work like this: Water is released during periods of demand. Then, when the demand diminishes, valves at the reservoir open so that the reservoir can refill with water.

The watershed tender controls the equipment to regulate the waterflow through the aqueducts and floodgates, allowing the water to flow by gravity to the areas below. The tender reads gages and meters to control the specified waterflow, water levels, and water pressure in the reservoir. This worker might also tend heating apparatus to prevent the freezing of valves and gates or add chemicals to the water to retard organic growth such as algae. In most cases, the watershed tender must also patrol the area around the reservoir to detect property damage and trespassing.

A person in this work must maintain records concerning such information as water levels, turbidity, temperature, and flow rate. One of the most important requirements is the ability to exercise good judgment and deal with practical problems such as an equipment malfunction or other emergency and to decide on the best way to handle it.

Good manual skills and coordination are needed to work with handtools in operating and maintaining the equipment. Good vision is also important to take accurate readings of the controls and dials and to inspect the reservoir. This work requires medium physical strength. It also requires working outside and around water where the conditions are wet and humid.

Job Requirements

Most employers prefer persons with a high school education; machine shop courses would be especially valuable. Employers are somewhat flexible, however, and may consider experience as good background for this work.

Experience as a [illegible] or a lower level worker can be valuable in demonstrating your skills and a willingness to accept responsibility.

These duties are [illegible] frequently learned through on-the-job training and technical instruction under an experienced worker or supervisor.

Opportunities

With experience, a watershed tender could perhaps advance to foreman or other supervisory position.

A limited number of openings in this work should occur as a result of attrition.

DOT code: Watershed Tender 954.382-018

Research, Development, and Design Occupations

Extensive research and planning go into solving water pollution problems. Water pollution analysts combine engineering and scientific talent to deal with them. Technicians aid in data collection by collecting water and wastewater samples, conducting field tests, checking computerized data reports, and many other tasks.

Hydrologic engineers, sanitary engineers, industrial-water-treatment engineers, as well as civil, chemical, and mechanical engineers also work on water resource and water pollution problems. Drafters assist in preparing the drawings and specifications for piping systems based upon the designs of the engineers.

Other projects require the work of aquatic biologists, oceanographers, hydrologists, and other professionals. Specialized technician positions include estuarine resource technicians and hydrographers or hydrologic aides.

Aquatic Biologist

Aquatic ecologist

Aquatic biologists study plants and animals living in water and the environmental conditions affecting them. They examine various types of water life, such as plankton, worms, clams, mussels, and snails. Today some of these professionals specialize in investigations concerned with water pollution and water quality management studies. They determine, in advance of natural resource development, the probable ecological effects of proposed activities on surrounding human, plant, and animal populations. They advise management on which ecological factors can be manipulated safely to enhance resource use for the public benefit and protect long-term values to society.

Some aquatic biologists conduct field surveys and investigations to obtain water quality data such as salinity, temperature, acidity, light, oxygen content, and other information to determine their relation to aquatic life. For example, they sample bottom deposits of rivers, lakes, streams, and marine waters to collect data. Under varying climatic conditions this work can be arduous. Some aquatic biologists wear diving equipment to collect data.

Aquatic bologists spend much of their time in the laboratory. Here they perform biologic tests and analyses of water samples to identify pollutants or nuisance conditions. They must be familiar with research techniques and complex laboratory equipment.

These biologists are expected to advise management on environmental questions and make recommendations concerning proposed water pollution control activities. For example, they advise engineers on the biological aspects of wastewater treatment plants. They assist in the review of applications for the use of herbicides and related chemicals. They evaluate the biological effect of point and nonpoint discharges in water. They review grant proposals for demonstration projects with potential impact on water quality. They attend planning sessions at local, State, and Federal Government levels. They sometimes testify as expert ecologic witnesses for legal actions.

As specialists in environmental studies, aquatic biologists may direct other personnel, such as technicians and field personnel, in research projects. With experience, they may work as project leaders, program directors, or supervisors.

To be successful in this occupation, a person must write clear, complete, and technically accurate reports and must speak effectively. Other important traits are intellectual curiosity, persistence, thoroughness, and attention to detail.

Aquatic biologists work inside, usually in laboratories, and outside when conducting surveys and investigations. There may be considerable standing involved in laboratory work. Good eyesight, especially color perception, manual and finger dexterity, and eye-hand coordination are also important to perform laboratory tests.

Job Requirements

A bachelor's degree with specialization in biology or a physical science is usually adequate for entry into this work. An advanced degree is helpful in most cases for advancement and many aquatic biologists have graduate degrees. For many positions above the entry level, experience can be substituted for education. Preference, however, is usually given to candidates possessing qualifications over the minimum requirements. For example, experience that includes publishing research studies and other documentation is also considered in evaluating qualifications.

Students should have a good foundation in a biological science. They must also have a basic knowledge of the principles of land and water resource research, planning, management, and use; principles of environmental ecology; limnology and oceanographic investigator methods; statistical methods; the effects of waste materials and natural substances on water quality and biota; and other related subjects.

Opportunities

Research and development, especially in long-range planning, should receive continued emphasis. As pollution control requirements and deadlines become more stringent, greater emphasis will probably be given to the study of the effects of pollution on water life.

An aquatic biologist could begin as a trainee and perform routine laboratory assignments and biological surveys and investigations. With experience, the individual could advance to more complex assignments and even become a project leader or supervisor. Some aquatic biologists serve as top staff advisers on environmental ecology at the regional level, or higher, or direct important research projects in private industry.

Aquatic biologists are employed by State and Federal water quality and pollution control agencies. They also work in private consulting engineering firms and in research and development.

DOT code: Aquatic Biologist 041.061-022

Drafter, Water and Sewer

Drafter, civil engineering
Drafter, construction
Drafter, engineering

These drafters perform highly specialized drafting work. In the construction of wastewater treatment plants, water purification plants, and other water pollution control projects, there is an intricate network of complex piping systems for the control of water, wastewater, sludge, and gas. Drafters prepare plans and detailed drawings and specifications for the planning and construction of the piping systems of water and sewer projects. These drawings are based on the rough sketches, plans, and specifications prepared by engineers, architects, and designers.

These drafters plan the layout of the pipe sections allowing for equipment, machinery, passageways, and connections. This intricate system must be incorporated into the architectural and structural features of the plans. The drafter must be knowledgeable about a wide variety of piping components and other fittings and show this information on the plans and specifications. The final drawings contain a detailed view of the plans, indicating dimensions and tolerances, joining requirements, and other information.

In preparing drawings, they use compasses, dividers, protractors, triangles, and machines that combine the function of several devices. They also use engineering handbooks, tables, and slide rules to help solve problems.

To be successful in this work, a person must be able to understand and apply technical knowledge and theoretical

principles involved in drafting. This close, detailed work requires a high degree of accuracy. Good eyesight, eye-hand coordination, and finger dexterity are also important.

Job Requirements

Graduation from a technical or vocational school is usually the minimum educational requirement. Many employers ask for up to 2 years of training which could be obtained in a junior or community college, university, or technical institute. It is also possible to qualify with some combination of on-the-job training and education. A basic drafting certificate program usually extends for 1 year.

A person interested in a career in drafting would do well to take mechanical drawing, mathematics, physical sciences, and drafting in high school.

A typical drafting program offered in a junior or community college includes courses in English and technical report writing; basics in graphics, including the use of instruments, lettering, drafting, geometrical instruction, and other topics; advanced engineering drawing, including topics such as descriptive geometry, perspective drawing, intersections and development, graphical analysis and computation; technical illustrations; technical mathematics; and physics.

Opportunities

A drafter could begin as a tracer making minor corrections and tracing drawings under the supervision of a senior drafter. With experience, this person could advance to detailer, checker, senior drafter, or supervisor.

Employment for piping drafters should provide favorable job opportunities throughout the 1980's. Jobs are expected to increase with new construction and expansion of wastewater treatment plants.

In many areas, experienced piping drafters are in demand. With the increase in planning and construction of new and advanced treatment facilities and the high degree of skill required for this work, openings for qualified drafters, who specialize in drawing piping systems for water and sewer projects, should continue.

Drafters are employed in private industry with architectural and engineering firms. Drafters also work for municipalities and districts having engineering departments.

DOT code: Drafter, Civil	005.281-010

Estuarine Resource Technician

Environmental technician

America's coastlines are fringed by sprawling areas where salt and fresh water meet. These areas, or estuaries, commonly identified as bays, inlets, sounds, sloughs, salt marshes, and lagoons are fertile, productive zones where a variety of fish, shellfish, migratory birds, and animals live.

Today, the estuaries receive municipal and industrial wastes and pollution from construction and many other sources. Biologically, chemically, and physically, estuaries are a complex environmental system and skilled personnel are needed to study these areas.

Estuarine resource technicians, or research assistants, work with scientists and oceanographers to study a variety of complex environmental problems. They work in biological and chemical laboratories to investigate problems of water pollution and how it affects different forms of life in estuaries. They maintain, calibrate, and operate instrumentation both shipboard and in the laboratory in collecting data. They perform a variety of field and laboratory work using sampling and analytical methods employed by water quality laboratories.

In some positions, these technicians work outside much of the time. To do field work, a person should be in good physical condition and like working near, on, and even in the water. Diving gear may be worn to collect samples and conduct field studies. Finger-manual dexterity, eye-hand coordination, and vision are important in order to perform these tasks.

Technicians write technical reports of various types; good grammar and composition are essential. They work with scientists, oceanographers, the public, and representatives of the government.

Job Requirements

A person with an associate arts degree (2 years) with emphasis on mathematics and the sciences can usually qualify for this technician work. A program that includes both field and laboratory experience is especially valuable. In most cases, these courses are applicable to the requirements of a bachelor's degree if the student wishes to continue in a related field, such as biology or chemistry.

A typical 2-year curriculum includes courses in biology such as applied aquatic biology, zoology, and ecology; methods of hydrobiology; microbiology; and marine instrumentation. Other courses are wastewater operations or industrial waste control and chemistry and courses in English, speech, mathematics, and pollution abatement technology.

Field work is necessary in learning how to collect data about rivers, estuaries, and the ocean. Courses that emphasize laboratory and field exercises such as sampling procedures, qualitative and quantitative surveys, and statistical analyses are also important.

Opportunities

A graduate of the appropriate associate arts degree program might later decide to continue for a 4-year degree in a related field of biology or chemistry. An individual could gain valuable work experience and have a close look at the work before deciding whether or not to continue in the field. However, a bachelor's degree is usually required for advancement.

There is a need in this area for a limited number of research assistants and technicians of well-rounded background.

These positions are found in private industry and with Federal and State government agencies. Most laboratories and centers are concentrated near coastal areas.

DOT code: Pollution-Control Technician	029.261-014

Hydrographer

Hydrographers analyze hydrologic data to determine trends in the movement and utilization of water. They measure waterflow and pressure in streams, conduits, and pipelines and record the data. They collect data by measuring water levels in lakes, reservoirs, tanks, rivers, and navigation pools. They measure the depth of water in wells and test holes to determine the ground water level. They sometimes measure snow characteristics to evaluate the water yield from snow runoff. They calculate seepage and evaporation rates for dams and reservoirs.

Taking these measurements requires accuracy and attention to detail in planning the work, checking and operating mechanical and electrical instruments, and in recognizing significant deviations in the results obtained. These technicians must maintain measuring equipment in good condition, testing electrical equipment for shorts, repairing or replacing broken parts, and cleaning and greasing the equipment. They check the gage settings to assure that the readings are accurate.

Hydrographers prepare graphs, tables, and charts to represent these water patterns. This involves the application of arithmetic, algebra, and often the use of computer programs. Sometimes the graphs, charts, and tables are prepared manually.

At higher levels, a hydrographer works on more complex hydrologic investigations and studies. For example, a hydrographer might plan and determine the basin runoff and develop reservoir inflow hydrographs from climatological and stream flow data; or conduct studies and comparative analyses of data collected in order to refine forecasting techniques. Other duties could include preparing discharge forecasts or reservoir manuals, planning reservoir regulation to provide flood protection downstream, and other tasks.

Collecting data and performing field surveys requires working outside, even in inclement weather.

This work requires medium strength to set up, adjust, and repair recording equipment. Sometimes hydrographers assist in constructing new gage installations. Good manual and finger dexterity are important in maintaining equipment, taking measurements, and preparing charts and graphs using drafting tools. Good eyesight is needed for accuracy in readings and computations of data.

Job Requirements

In some instances, a person with a high school education could begin as an aide and, through on-the-job training, advance to the position of hydrographer. This would probably require up to 3 years experience or some combination of training and experience.

Some employers prefer a person with a bachelor's degree and a strong background in courses such as English, industrial or environmental technology, drafting, survey work, and especially mathematics. Experience can usually be substituted, in part, for the education requirements.

Opportunities

Hydrographers can usually advance to higher level duties involving more complex studies and investigations. Some may have supervisory duties.

An engineering degree is probably necessary to advance to professional level positions.

A limited number of hydrographers work for the Federal Government, for State agencies and in private industry.

DOT code: Hydrographer	025.264-010

Hydrologic Engineer

Water engineering was probably man's first science. Water works engineering made possible the development of the valleys of the Nile in Egypt, the Tigris and Euphrates in Mesopotamia, the Indus in Northern India, and the Hwang Ho in China. Early engineers built canals, aqueducts, and reservoirs to bring water from mountain sources for growing populations. The Romans were probably the best waterworks engineers of all and brought water engineering to new heights of usefulness and durability.

Today, the hydrologic engineer designs and directs construction of power and other hydrologic engineering projects for the control and use of water. These engineers work on many projects - artificial canals, dams, reservoirs, booster stations, and flood control programs. They also work in research and study problems such as soil drainage, conservation, and flooding.

In water supply and flood plains management programs, these engineers examine and analyze large-scale, complex plans and specifications of dams, bridges, culverts, retaining walls, fills, pipe crossings, channel improvements and relocations, and other projects. They prepare detailed technical reports on hydrologic, hydraulic, and structural features of projects to support their recommendations. Some-

times they investigate complaints related to flooding and illegal construction and the safety of existing dams.

In some positions, these engineers prepare complex studies and reports related to the work. They maintain inventories of water resource information pertaining to rivers, streams, lakes, ponds, flood control, and flood management. They conduct hydrologic analyses of droughts, storms, rainfall, and flood runoff records in order to develop basic data and comprehensive plans for the alleviation and prevention of floods. They may work with the U.S. Weather Bureau and civil defense authorities in flood forecasting and warning. Some assignments might include physical surveys and property appraisals to evaluate the economic and social factors in reservoir development.

An hydrologic engineer could specialize in one aspect of the work such as planning, design, operation review, or surveillance studies; or work on a particular type of project. For example, some engineers specialize in irrigation projects and are known as irrigation engineers. They plan, design, and oversee the construction of irrigation projects which distribute water to agricultural lands. They plan and design the irrigation features and direct construction of irrigation systems such as dams, canals, and ditches.

Job Requirements

Hydrologic engineering is a specialization of civil engineering. A bachelor's degree in civil engineering provides the foundation for entry into this work.

In addition, persons entering this field must have 2 to 4 years of professional engineering experience in the planning, design, or construction of water projects. Graduate work can usually be substituted for experience; some employers require a master's degree in hydrology or hydraulics.

Opportunities

The conservation and distribution of water to agricultural lands and the conversion of water into electric power should command attention throughout the 1980's. In addition, increased recognition of the need to protect and conserve one of our most valuable resources, water, and to convert water to electricity should mean more jobs for hydrologic engineers.

DOT code:		
	Hydraulic Engineer	005.061-018
	Irrigation Engineer	005.061-022

Hydrologist

Hydrologists study the distribution, disposition, and development of the waters of land areas, including the form and intensity of precipitation, and the modes of return of water to the ocean and the atmosphere. Hydrologists study the water cycle, both above and below the ground.

Hydrologists map and chart water flow and disposition of sediment. They measure changes in water volume as a result of evaporation and melting snow. They study the nature and movement of glaciers; storm occurrences; the rate of ground absorption; and the ultimate disposition of water.

Hydrologists evaluate data obtained in reference to such problems as forecasting flood and drought, soil and water conservation, and planning water supply, water power, flood control, drainage, irrigation, crop production, and inland navigation projects.

Flood forecasting is an important responsibility of the hydrologist: Some floods are seasonal, as when winter or spring rains and melting snows drain and fill basins with too much water too quickly. Others are flash floods, raging torrents that sweep through river beds after heavy rains. Timely forecasting saves lives and reduces property damage. Hydrologists, when they issue water supply and river forecasts, use radar reports and high speed digital computer systems.

Hydrologic studies are used in planning and designing everything from airport culverts and small farm ponds to storm sewers for urban developments, from drainage systems for shopping centers to large dams. Hydrologic studies are used in developing flood insurance programs. Hydrologists participate in the broad planning aspects of total water resources programs.

Some hydrologists spend part or even all of their time in research. For example, studies are underway on the energy balance computation of snowmelt, the mechanics of flow in rivers, the mechanics of erosion and deposition of sediment causing major changes in river geometry, and many other subjects. In order to improve basic data measurements, considerable effort is being expended on the use of digitized radar data, the use of geostationary satellites to collect and transmit hydrologic data, and procedures for improved network design. The aerial monitoring of snow, as opposed to point measurements, reduces expenses while maintaining designed accuracy, and provides a fast evaluation of flood potential from melted snow.

Other hydrologists analyze and forecast oceanographic phenomena and provide information to support shipping, fishing, offshore drilling and mining, and marine recreational activities.

The work of the hydrologist is varied and can involve a part of or all phases of the water cycle and pertain to local, national, or even international water problems.

In some positions, hydrologists may be required to work shifts because data collection and forecasting continues round-the-clock. This is light physical work requiring considerable walking and standing. Manual and finger dexterity, good eyesight, and coordination are also important in performing these tasks. Communication skills are important in order to work with representatives of resource agencies, local communities, State agencies, and others in planning activities.

Other desirable traits include an inquisitive mind, resourcefulness, planning ability, and the ability to write clear, concise technical reports.

Job Requirements

A bachelor's degree or higher with a major or approximately 30 hours in a physical or natural science or engineering is usually the minimum requirement for entry into this work. The individual must have a good understanding of the water cycle.

Research or teaching positions usually require the completion of a master's or doctorate degree. In some cases, professional experience may be accepted in part for graduate education.

A solid background in physics, chemistry, and mathematics is an important requirement for hydrology work. Other courses such as geophysics, geology, forestry, meteorology, oceanography, and biology, also are valuable to the hydrologist, depending upon the area of specialization. A course in computer systems fundamentals is also valuable in many positions.

Hydrologists are expected to keep abreast of new developments in their field.

Opportunities

Hydrologists are employed by Federal, State, and some local governments. Others work for regional or area planning authorities, private industry, research firms, and consulting firms.

There should be openings for qualified hydrologists throughout the 1980's.

DOT code: Hydrologist 024.061-034

Industrial-Water-Treatment Engineer

Water, as it comes from the tap, is often unacceptable for industrial use and must be given additional treatment. For example, in many industries water is an essential ingredient of the product. Products like food, beverages, and drugs often require water purification standards above that provided by municipal or public water suppliers. Water also plays an important part in the operation and maintenance of machinery and equipment; improperly treated water can cause its deterioration.

Some chemical engineers specialize in water treatment processes used in industrial production. These engineers are sometimes called industrial-water-treatment engineers. They develop specialized water treatment processes and chemical treatments to suit industrial needs.

When these engineers work for consulting firms they may be involved in a variety of industrial water treatment situations. They also work with representatives of companies selling chemicals used in water treatment. As consultants, these engineers work with plant engineers, managers, and other professionals. Sometimes they design special machinery and equipment to meet a manufacturer's need. Or they may prepare sophisticated research studies on water treatment problems. They keep a close watch on treatment processes in order to maintain and improve the quality of the product and find more efficient ways of operating the plant.

They develop water treatment plans to solve water quality problems. For example, industrial-water-treatment engineers develop treatment processes for water used in the operation of machinery and equipment such as boilers, condensers, and cooling towers in order to minimize scale and corrosion and many other problems. Or, where water is part of the product such as a beverage or food, they may solve a taste problem.

This is light work and may require considerable walking and standing. Good communication skills are important in working with professionals, operators, and management.

Job Requirements

A bachelor's degree in chemical engineering is usually the minimum educational requirement and many employers prefer a master's degree in chemical or environmental engineering. Large employers or industries usually seek persons with many years' experience in water analysis studies and design projects.

Opportunities

There should continue to be opportunities in this work into the 1980's.

Industrial-water-treatment engineers work for private consulting engineering firms that deal with a wide range of treatment problems. Some of these engineers work for the larger companies and concentrate on the unique problems of a particular industry. Others work for companies that specialize in selling chemicals to water treatment facilities.

DOT code: Chemical Engineer 008.061-018

Oceanographer

Oceanography is the science of the sea. Because it has to do with many sciences - biology, chemistry, physics, geology, mathematics, and other disciplines - it is difficult to define. The oceanographer studies all classes of phenomena in relation to one place, the ocean.

In recent years, the dangers of pollution from underwater mining of gas and oil, tanker oil spills, and industrial and domestic waste have led the public to look toward the oceanographer for ways to safeguard our water.

Twenty-nine percent of the American population lives along the coast where industries spill their wastewater into the ocean. In addition, urban sewer systems carry domestic wastes, sometimes treated and sometimes not, into the oceans. The oceanographer must study the effect of these pollutants on the ocean and advise the sanitary engineers as to what corrective action is needed. At the same time, oceanographers are also exploring the ocean for new freshwater sources.

Oceanographers may work in or on the ocean or, if they prefer, they can choose to work inside. This work requires the physical capacity to perform light work. Important aptitudes include the ability to visualize spatial relationships and to perceive form and clerical details; finger-manual dexterity and eye-hand coordination are also necessary. Good eyesight, including color perception, is important.

To become an oceanographer, a person should be interested in science and be capable of doing good work in science and mathematics courses. Scientific work also requires an analytical mind and effective communication skills.

Job Requirements

An oceanographer usually concentrates on the natural sciences in undergraduate work and should major in one of the basic sciences. A typical undergraduate program includes courses in physics, chemistry, mathematics, general zoology, and physical geology. Although it is possible to obtain an undergraduate degree in marine sciences, master's degree programs are more common.

In the past, many oceanographers gained their specialized training and experience through ocean work rather than

postgraduate academic programs. The title, oceanographer, can still be obtained this way as well as with a graduate degree. Most oceanographers entering the field, however, have graduate degrees and a Ph.D. is becoming the best foundation for advancing in this field.

An oceanographer can specialize in research or in engineering. There are many specializations and combinations of subjects in studying the oceans; persons in this field must be adaptable and creative, depending upon the problem to be solved. The oceanographer must have the ability to plan, execute, and interpret research.

An oceanographer is expected to continue postgraduate education through short courses, refresher courses, professional activities, and keeping abreast of current literature.

Opportunities

At the beginning of World War II there were perhaps 50 people who could be called oceanographers. By the end of the war that number had increased to about 300. Since then, budgets for ocean research have increased steadily and we can assume that there will continue to be a need for qualified professional oceanographers, both men and women.[1]

The problem of worldwide waste disposal in the sea is a complex one requiring continued study. The assimilation and diffusion in coastal waters of urban and industrial wastes is expected to necessitate future large investments.

Oceanographers work in science, research, and educational organizations, government agencies, and private businesses. The largest number of oceanographers work in States that border the ocean, especially California, Maryland, and Virginia. Most oceanographers are employed by the government and by the universities, where research is their principal work.

DOT code:		
	Oceanographer, Geological	024.061-018
	Oceanographer, Physical	024.061-030

Sanitary Engineer

Public-health engineer

Many opportunities are open to the individual who enters the sanitary engineering field. Sanitary engineers, sometimes known as public health engineers, work in a variety of areas. They design and direct construction and operation of projects such as waterworks, wastewater treatment plants, and other sanitary facilities. Or, sanitary engineers may be responsible for a major segment of a public health engineering program such as sewage disposal, water pollution control, or water supply. Sanitary engineers also work in the development of watersheds and direct the building of aqueducts, filtration plants, and storage and distribution systems for water supplies in some States.

Some sanitary engineers work in environmental protection programs and investigate complex stream pollution problems. They make detailed engineering investigations and studies of sewage and industrial waste treatment. They investigate conditions in public waterways, industrial plants, public and private sewer systems, industrial waste treatment plants, and sewage disposal plants. This work may involve collecting samples, making flow measurements, and preparing detailed reports, sketches, plans, and diagrams of factors affecting the pollution problem. The engineer must then evaluate the condition of treatment facilities and the effectiveness of the treatment process.

In many States, sanitary engineers plan and supervise the engineering, construction, and operation of all sewage and industrial waste treatment projects and municipal water supply programs. Before issuing discharge permits they review plans and specifications for construction, modification, and maintenance of water systems and treatment plants to insure that pollution control requirements are met. They consult with and advise local officials and civic groups concerning the type, location, cost, and operation of treatment plants and may assist them in applying for Federal aid. In some States, they train treatment plant operators and serve as technical advisors on sanitation problems.

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[1] Norman H. Gaber, *Your Future in Oceanography* (New York: Arco-Rosen Guidance Series, 1976).

Sanitary engineers also develop strategies and guidelines for waste load allocations, treatment levels, operational requirements, optimal locations for treatment plants, and other plans.

Some sanitary engineers become water-treatment-plant engineers and specialize in the treatment of water in a purification plant. Or, as sewage-disposal engineers, they may specialize in the design and oversee the construction and operation of a sewage disposal system.

Sanitary engineers work both inside and outside. Much of their work is performed in an office, at a desk or drawing board. They also work outside at construction sites and, in some cases, are required to travel—even to foreign countries.

To succeed in this work individuals must be able to learn and apply basic engineering principles and methods to water pollution control problems. They must be able to plan and organize their work independently and to exercise judgment in evaluating situations and making decisions. They must present technical material, in reports, clearly and concisely, sometimes at public meetings and hearings. A logical mind and an interest in mathematics are indications a person would succeed in this work.

Although the work is light, engineers should have good manual and finger dexterity, eye-hand coordination, and visual acuity.

Job Requirements

Sanitary engineering is a recognized engineering specialty. It combines engineering training with a knowledge of the health sciences including biology, chemistry, bacteriology, and physics. It also requires a knowledge of the equipment and operation of water, solid waste, and sewage treatment plants and systems.

A sanitary engineer must first complete a 4-year course in chemical, civil, public health, or sanitary engineering. In addition the sanitary engineer must possess specialized training in sciences related to sanitation. For example, many sanitary engineers obtain a bachelor's degree in civil engineering and then specialize in sanitary engineering in graduate work. Master and doctorate degrees in sanitary engineering are becoming increasingly common. Consulting engineers and architectural firms often prefer candidates with a good foundation in a discipline such as civil or structural engineering followed by specialized training at the graduate level.

Sanitary engineers should be registered or licensed under the registration laws of their States.

Opportunities

There are many opportunities for qualified sanitary engineers. Communities must comply with more stringent clean water requirements; this means expansion of existing wastewater treatment facilities and construction of new plants. Engineering and architectural firms must design and oversee construction of these projects. This demand should continue into the 1980's.

Sanitary engineers work in many places: with consulting engineers and architectural firms or as independent consulting engineers, in research in the development of advanced wastewater treatment facilities and processes, for waterworks plants, wastewater treatment plants, State agencies, environmental protection agencies, health departments, and private industry. They work in all parts of the country but are usually near large commercial and industrial centers.

A substantial number of sanitary engineers are employed by various government agencies, local, State, and Federal. Most are employed by public works agencies and health departments.

DOT code: Sanitary Engineer 005.061-030

Water Pollution Analyst

Environmental scientist

Extensive research and planning are undertaken by water pollution analysts who investigate various alternatives and complete in-depth studies to arrive at efficient and practical means of dealing with water pollution problems.

Water pollution analysts conduct research studies to develop methods of abating or controlling sources of water pollution. Finding practical solutions to the environmental problem of water pollution requires intensive and comprehensive research and planning. Analysts must combine engineering and scientific talent to solve these problems. In some positions, the analysts are known as water quality analysts.

Analysts determine the data collection methods to be employed in research projects and surveys and sometimes direct the technicians in survey work. They synthesize a variety of data including information on existing discharges such as operating records, computerized data, existing studies, on-site interviews, and other information. Analysts prepare graphs, charts, maps, and statistical models from the synthesized data, using a knowledge of mathematical, statistical, and engineering analysis techniques.

Planning and research studies can involve both short-term and long-term projects. Water pollution control measures must be evaluated in terms of cost effectiveness, water utility effectiveness, environmental impact, and ability to be implemented. Environmental assessments include evaluation of many features and demand a multidisciplinary approach in arriving at the best solution to a problem. Assessments may include evaluations of soil and geologic conditions, rare and endangered flora and fauna, existing cultural resources, social impact, outstanding water quality considerations, and many other features.

These studies and projects are decisionmaking documents and present the pros and cons of various strategies in dealing with water pollution problems. The severity of the pollution problem must be measured by using various technical criteria. Detailed descriptions of proposals and documentation of options must be prepared. Often analysts participate in community citizen workshops or attend other meetings and gatherings to explain the features of pollution control proposals.

This work may involve travel, even to foreign countries. Sometimes water pollution analysts work outside in directing the collection of data, evaluating the site, or working with management. Persons who like to do well in science and research and have inquisitive minds would probably like this work. The individual should be in good physical condition and able to perform light work while in the field.

Job Requirements

Graduate training in engineering or science is usually essential for entry level work as a water pollution analyst. Many environmental analysts have doctorates. It is most important that analysts keep abreast of new developments and technology in the treatment of wastewater and water pollution control methods.

A bachelor's degree in chemistry, biology, geology, or engineering is a good foundation for this work. Undergraduate work should include courses in the sciences, mathematics, and statistics.

An advanced degree in sanitary, environmental, or chemical engineering, or one of the sciences is usually required for this work. It is essential that the individual have the interest and ability to apply analytical and research methods and techniques.

Each team member brings a specific area of expertise to the investigation—in engineering, chemistry, biology, geology, or a related field. Water pollution analysts may possess a variety of academic backgrounds; most, however, are able to apply a multidisciplinary approach to a specific problem.

The most important preparation for this work is to obtain a solid foundation, usually in one of the traditional disciplines and, at the graduate level, to acquire in-depth, specialized knowledge. This work demands experts and only outstanding individuals in a field will qualify. Each team member usually brings some combination of engineering and science backgrounds and applies these knowledges to complex environmental problems.

Opportunities

Young professionals entering this work often begin by doing more routine field work, such as leading a field sampling team. This provides valuable experience from the ground up in such important areas as collecting data, evaluating sites and, most important, dealing with managers and owners with tact and diplomacy. A person in this work must be especially skilled in public contact work because at the higher levels, dealing with management is crucial.

With 1 or 2 years experience in the field, the individual would probably be ready to advance to working level duties such as analyzing data, preparing charts, maps, and statistical models and working on assessment studies or other projects.

With additional experience and a master's or a doctorate, a person could become a team leader or even advance to a supervisory or administrative position.

Most water pollution analysts work for consulting engineers and research firms whose clients are municipal and local governments, the Federal Government, and private industry. Other analysts are employed directly by Federal, State, and local governments. Some water pollution analysts have individual consulting services. Others teach in colleges and universities.

Government grants for new and improved wastewater treatment facilities and water quality improvement should continue throughout the 1980's. New technological developments in treating wastewater and the increasing need for advanced treatment facilities will grow as water pollution control requirements are met.

DOT code: Environmental Analyst 029.081-010

Water Pollution-Control Technician

Environmental technician

A growing number of technicians are engaged in various activities related to water pollution-control projects. Water pollution-control technicians conduct field tests, surveys, and investigations to obtain data for use by environmental, engineering, and scientific personnel in determining sources and methods of controlling pollutants in water.

These technicians collect water samples from streams, rivers, lakes, or raw, semiprocessed, or processed water, industrial wastewater, and other sources. They must also set up monitoring equipment to obtain flow information and use various other technical recording, measuring, and testing devices to collect data.

Sometimes technicians conduct physical and chemical field tests to identify the composition of the sample. They must take precise, accurate measurements for on-site sampling work. Certain data such as temperature, turbidity, and pressure must be measured and recorded in the natural environment to obtain accurate data. The technician must maintain clear and accurate records of field work. In some cases, the technician uses dye testing techniques to trace the flow of water or locate sources of pollution.

An increasing amount of wastewater monitoring is being done with automatic sampling equipment. Technicians analyze computer printouts of data obtained using this equipment and laboratory results reported using computer terminals. Technicians analyze this data and prepare statistical reports, charts, and graphs to illustrate treatment patterns and trends which are used for further analysis by environmental engineers and scientists.

Technicians need good mechanical skills and should like to work with their hands in order to maintain and adjust the various collection, control, and testing equipment, and recording devices. Also, they must be able to read and interpret maps, diagrams, charts, manuals, and other materials and make precise computations of data.

This work frequently involves travel and, in some positions, technicians must be away for long periods of time. Travel could be within the United States, or even to a foreign country, to collect data.

When working on a survey, technicians spend much of the time outside, occasionally during inclement weather. They drive cars or trucks on assignments and may be required to operate a small boat. This work can be hazardous near water.

An individual should be in good physical condition for this work and be the kind of person who works well as a team member.

Job Requirements

Persons can qualify for these jobs with an associate arts degree with specialization in chemical technology, science, or a related field. Although employers are somewhat flexible, they usually require the specialized technical training available at vocational-technical schools, junior and community colleges, and other institutions.

Most employers prefer applicants who have had some specialized work experience. In many places, employers want 1 year of experience in work involving surveys and operation of collecting, measuring, or testing equipment, or in related technical work. Applicants often may substitute additional education for experience. College credits in natural, chemical, environmental, biological, or engineering sciences can usually be substituted for experience requirements. Mathematics courses are especially valuable.

It is not uncommon for engineering firms to use this position as the trainee or entry level for professional engineers and scientists. This provides new professionals with the experience and training needed for more advanced work. The professional must be able to deal with plant managers and owners and to plan and organize the work.

Technicians are usually provided on-the-job training under a professional engineer or scientist. Sometimes, they work as members of a team under the close supervision of the team leader.

In this occupation it is important to have a basic knowledge of and familiarity with operations of water and wastewater treatment plants; legal requirements and procedures for collecting samples; some knowledge of pollution control laws, rules, regulations, and policies; and fundamental concepts and principles of environmental investigations, inspections, and sampling techniques.

Opportunities

For advancement, most employers require a bachelor of science degree in one of the traditional disciplines such as civil, mechanical, or sanitary engineering or in science.

There has been an increased demand for technicians within private industry and with consulting firms to assist professionals in the data collection and verification for a variety of water pollution control projects. The turnover in this type of work may be somewhat high because of the travel requirements and because it is often a trainee position for professionals. Also, a certain number of technicians are hired on a temporary basis to meet production schedules.

Other technicians perform similar duties in government and regulatory agencies and in private industry.

The development of new treatment processes to treat industrial waste, the design of advanced wastewater treatment facilities, the construction of new wastewater treatment plants, and the expansion and improvement of existing plants should mean the continued demand for technicians.

DOT code: Pollution-Control Technician 029.261-014

Regulation and Control Occupations

Water pollution-control engineers work in a number of areas to insure that water pollution-control requirements are met. Oil pollution-control engineers are concerned with the prevention, control, clean-up, and disposal of oil spills.

Treatment-plant instructors plan and conduct training programs for personnel to upgrade their skills and meet certification requirements.

In addition, water and wastewater monitoring requires the efforts of various inspectors, technicians, assistants, and some aides.

Oil Pollution-Control Engineer

Today, "oil spill" has become a household word. It is a major concern of the oil industry, faced with supplying an ever-increasing demand for oil and petroleum products without the risk of oil spills.

Although oil spills probably cannot be entirely prevented, steps are being taken to reduce the probability that they will

Oil slick surrounds the Statue of Liberty in New York Harbor, 1973.

occur. For example, engineers plan and maintain plant surveillance programs over machinery and equipment for spills from tank racks, tank forms, piping, valves and flanges, unused piping dikes and other equipment. They determine inspection procedures for personnel to monitor underground pipe lines. They plan strategically located well-point grid systems to monitor subsurface pollution. As part of surveillance programs, they insure that workers check valves, pipes, and other facilities for small leaks; inspect dikes, storm sewer systems, and valves for leaks or faulty operations; and perform many other tasks.

Places where spills are likely to occur must be continually monitored. Engineers plan inspection programs to control waterfront spills in checking loading arms, check valves, hoses, lighting, and other equipment. They insure that information such as tides, currents, general water movements, wind, and other seasonal changes are posted to prevent accidents. Sometimes they advise service station personnel concerning controlling or monitoring oil and gasoline spills or leakage in underground storage tanks, aisle drains, oil change pits, waste tanks, and catch basins.

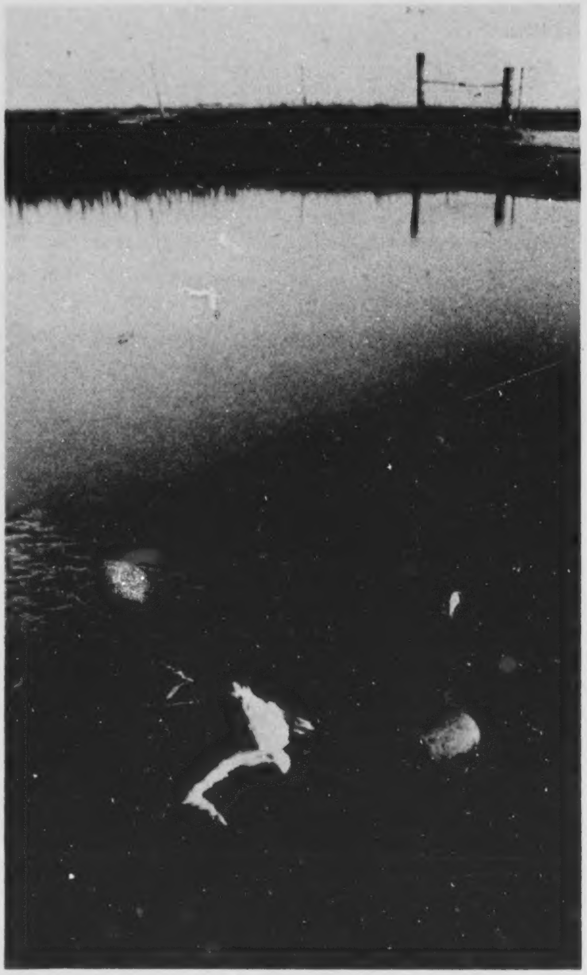
No perfect control or cleanup method exists. Engineers must evaluate and decide upon the best method on a case-by-case basis. Control plans are critical in the event of a spill. If the spill is near shore, mechanical techniques are generally used effectively. In offshore spills, oil recovery is more complicated. These engineers prepare contingency plans to control waterborne spills under all conditions, day and night, in fair and foul weather, on- and offshore.

These engineers develop containment and cleanup plans for all conditions under which a spill might occur. For example, they correlate spill drift rates, crew reaction time, and secondary reaction time to plan locations for equipment and sites for controlling and recovering spills. In calculating reaction time, they consider such factors as boat speeds, spill speed, water current speed, wind velocity, and other data. They must also calculate the response time of cleanup contractors and assistance from cooperatives. These plans must be reviewed and updated regularly to insure that all data is correct.

When a major spill is first discovered, containment of the oil is the most important single action that can be taken. The use of mechanical equipment is the most common method of oil removal. In some cases, methods such as sinking the oil, dispersion of the oil, the use of absorbents, and even burning oil is used. The engineer must decide on the best strategy and the methods to be used in a particular spill while considering such factors as wind direction and velocity, sea conditions, towing loads, shape and density of the slick, time, and vessels passing through it. Directing the control and cleanup of a major spill requires working under difficult conditions because spills can occur during stormy weather and away from land.

In some positions, these engineers plan training programs for crews to reduce response time. They also schedule regular drills to be sure that machinery and equipment are in good working order and that crews are properly trained.

Maintaining accurate and precise records of control and cleanup work is essential. A daily log is kept of all activities, including instructions to contractors, instructions of the on-scene-commander (either U.S. Coast Guard or EPA representative), samples, and other information. Tape recorders and cameras are also used to record activities. The many details which cannot be overlooked are contacting the safety department to monitor the atmosphere for volatile or hazardous materials, contacting the game commission and local wildlife representative where waterfowl may be involved, arranging contracts for additional cleanup services, and being certain that all environmental control requirements are met. These engineers work with local fire departments to alert them to the hazards of potential oil spills such as water intakes for plants or drinking water, surface storm water drains, marinas, swimming beaches, bird and other wildlife sanctuaries, tidal flats, and other sensitive areas that might be affected by the spill.



Other duties include planning for the removal and disposal of the recovered oil, determining the types of equipment required by the plant, planning storage locations of equipment, and selecting sites for cleaning equipment.

This work is usually performed indoors. However, an emergency could require working outside, around water, oil, and other materials, possibly during inclement and hazardous weather.

Job Requirements

The minimum education is usually a bachelor's degree in chemical or petroleum engineering, although mechanical or civil engineering are also acceptable.

The major requirement for this work is many years experience in operations and all phases of oil pollution control.

Mathematics is especially important in order to calculate costs and prepare highly complex records and reports.

Opportunities

Environmental control regulations require highly trained professionals to interpret environmental control laws and develop plans to insure that industry meet these requirements at minimum costs.

These engineers work for petroleum companies, private cleanup contractors, cooperatives, and Federal and State agencies concerned with the prevention, control, cleanup, and disposal of oil spills.

There should be opportunities in this field throughout the 1980's for highly qualified and experienced engineers.

DOT code:	Chemical Engineer	008.061-018
	Petroleum Engineer	010.061-018

Water-Pollution-Control Engineer

Protection of our water is the water pollution-control engineer's main concern and to accomplish this he works in a variety of areas.

State governments have primary responsibility for control of sources of water pollution entering the natural streams and waterways. Although they are often called environmental engineers, some of them work exclusively in water pollution control programs. In some positions, they are called water quality-control engineers. They act as consultants and carry out regulatory work to insure that water pollution control regulations are met.

These engineers examine and analyze engineering plans and specifications for construction projects such as water supply systems and plants, industrial and wastewater treatment systems, and collection systems. They review design features and evaluate plans to determine that pollution control requirements are complied with. Other duties might include inspecting the site to be sure that all surrounding environmental features have been considered, attending preconstruction conferences, and advising contractors concerning pollution control regulations and other critical details of the projects.

One of the most important responsibilities of these engineers is to advise management, operators, and officials on pollution problems and how to handle them. For example, they inspect large, municipal and industrial treatment plants to insure that they are operating within the effluent limitation requirements. They recommend issuance or denial of National Pollution Control permits for construction and operation of treatment facilities. They assist municipalities in preparing State grant applications and monitor State planning and construction funds.

At higher levels, these engineers conduct major environmental engineering studies to evaluate water pollution problems and develop methods of pollution control. In doing this, they prepare cost estimates and compile data for detailed technical reports.

In private industry, these engineers are responsible for wastewater treatment facilities and for compliance of plants with pollution control requirements. For example, they obtain discharge permits, develop environmental impact assessments and treatment processes that meet environmental requirements and, at the same time, try to minimize costs of production. They meet with government representatives and local planning agencies to discuss water pollution problems. For major plant changes, they usually work with consulting engineers.

To succeed in this work, the individual should have a solid background in engineering and mathematics. Other important qualities are a logical mind and strong organizational ability.

This is light work, performed inside, with occasional field inspections.

Job Requirements

The minimum educational requirement for entry into this work is usually a bachelor's degree in engineering. Most employers require a minimum of 2 to 4 years of engineering experience. Employers in private industry seek engineers with many years experience and a background in wastewater treatment.

Any experience covering water pollution control or other environmental activity is usually acceptable experience to get started with one of the governmental agencies.

It is also necessary to know the laws, codes, and regulations of pollution control; this can usually be acquired on the job. A knowledge of the chemistry and bacteriology of water, sewage, and liquid waste is important too.

A professional engineer's license is usually required.

Opportunities

Increased appropriations are available for new construction in wastewater treatment plants and related projects under the Clean Water Act of 1977. This extension of grants means many local construction projects for most areas in the country. Stricter pollution control requirements should mean continued need for water pollution-control engineers.

These engineers work in State, regional, and Federal agencies. They also work for consulting engineering firms, architectural firms, and private industry; a few are self-employed.

DOT code: Pollution-Control Engineer 019.081-018

Water Pollution-Control Inspector

Water quality monitoring requires a network of inspection and reporting procedures to insure that water pollution control standards are met.

Water pollution-control inspectors inspect water and wastewater treatment facilities that serve small communities, mobile home parks, individual homes, and many other places. They inspect many point sources of discharges into the waterways. To do this, they travel to water and wastewater facilities and other sites where discharges enter streams and rivers. They inspect the area for such features as obvious discoloration of water, sludge, algae, rodents, and other conditions. They also inspect the condition of the treatment facilities and observe the state of lagoons, settling ponds, and basins.

When unacceptable or suspicious conditions are present, they analyze the situation and decide what to do. They then advise the owner or operator of the environmental requirements on the best way of handling the problem.

Sometimes inspectors take grab samples of water or wastewater for laboratory analysis. In some positions, they may perform routine laboratory tests on wastewater samples.

Inspectors investigate minor complaints concerning water pollution. They complete detailed technical reports of investigations. They prepare charts, tables, maps, and other documents in order to present their findings concerning an investigation. Inspectors must be tactful and diplomatic in dealing with a variety of citizen complaints. Investigations may involve interviewing persons and collecting information from many sources in documenting their reports.

These positions require a substantial amount of paper work. For example, inspectors compile information and prepare permit applications for the construction and operation of small water and wastewater treatment facilities. Inspectors should be able to speak and write effectively in order to establish and maintain good working relationships with public officials, private business representatives, and the general public.

Good physical condition is required to perform light physical work because most positions entail a considerable amount of field work.

The titles for persons engaged in this type of work vary: Environmental specialists, environmental protection field inspectors, surveillance specialists, water quality specialists, or other titles, depending upon the agency.

Job Requirements

Most employers require as minimum education, a bachelor's degree in environmental science, chemistry, biology, or a closely related environmental discipline. Some employers also require 1 year's experience in technical or professional scientific work in an environmental control program.

Inspectors must be able to comprehend and interpret pollution control laws, rules, and regulations and advise owners, operators, and managers on these requirements. In most cases, this knowledge is acquired through on-the-job training under an experienced professional.

Persons in this work should be able to organize and plan their activities with a minimum of supervision.

Opportunities

With experience, inspectors can advance to more complex assignments and higher level positions. Some inspectors become supervisors or group leaders. For many of the higher level positions in these agencies, it may be necessary to obtain an engineering degree.

The number of positions in this field should continue to grow gradually. Because of increasing water pollution control requirements and the trend toward minimum professional standards, these jobs should provide opportunities for college graduates.

Inspectors work in Federal, State, and local regulatory agencies responsible for enforcing water pollution-control regulations. They also work in public health agencies.

DOT code: Inspector, Water Pollution Control*

Treatment-Plant Instructor

Generally speaking, well-trained personnel make a plant more efficient. Because operators are entrusted with a very large investment—the plant itself—all plant personnel must be well-trained and the investment fully utilized. Treatment-plant instructors plan and conduct training programs in water and wastewater treatment plant operations and maintenance to insure maximum efficiency and to provide that personnel meet certification requirements.

Treatment-plant instructors plan and conduct seminars, workshops, special courses, and a variety of other inservice training sessions. They demonstrate proper operation and maintenance techniques and explain the theory and background of the work. Training sessions cover such topics as the proper selection of sampling points, good laboratory techniques and procedures, recordkeeping, safety measures, and care of lift stations and collection systems. Courses are planned in consultation with municipal and industrial officials in order to tailor the instruction to the special needs of each plant. They perform other duties, such as screening applicants for the course, counseling and advising students, administering examinations, and making recommendations for improving basic courses.

Treatment-plant instructors also provide technical assistance and act as consultants to operating personnel and owners of water supplies, water and wastewater facilities, and sewerage and industrial waste control systems. They explain water pollution control laws and requirements to operators and owners. They act as troubleshooters and recommend improvements and changes in treatment processes. They serve as consultants to technical staff and operators on the operation of treatment equipment.

Some of these specialists work in the State certification program. They maintain examination records and issue certificates to operators based upon the different sizes and types of treatment plants.

Treatment-plant instructors must stay abreast of new developments in treatment processes to introduce new technology and specialized skills to those students in advanced programs.

To succeed in this occupation, a person must be able to communicate effectively and to maintain harmonious working relationships with operators, civic and industrial officials, engineers, and others. Sometimes instructors are asked to speak before civic groups to explain pollution control requirements or discuss the various treatment processes.

The work can involve frequent travel, although an instructor is usually responsible for the training within an assigned area.

Good manual dexterity, eye-hand coordination, and spatial ability are important to demonstrate operation and maintenance of equipment.

Job Requirements

Employers usually require at least 2 years experience in the operation and maintenance of wastewater treatment plants having both primary and secondary treatment facilities. Additional experience is necessary for water treatment plants. In addition, an instructor should have completed at least 9 months of training in wastewater and water treatment from a recognized vocational, technical, or trade school. In some States, college education, including substantial course work in engineering, chemistry, biological sciences, or closely related fields, may be substituted for experience.

This work requires an extensive knowledge of water and wastewater treatment technology and operations. A good foundation in mathematics, chemistry, and bacteriology is also important.

Opportunities

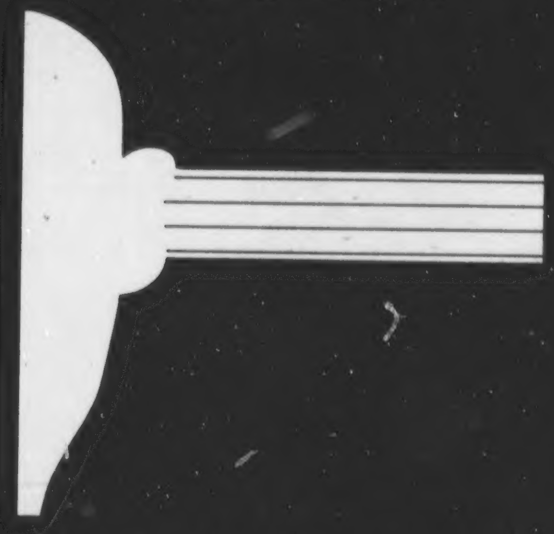
Statewide water pollution control programs are being developed in most States to insure the continued availability of trained and motivated personnel for the prevention, control, and abatement of water pollution.

As existing water and wastewater treatment facilities are expanded and new facilities constructed, operating and maintenance personnel will require training in new technologies and procedures in order to operate efficiently and meet certification requirements.

Most treatment-plant instructors work for State agencies and conduct courses at treatment plant sites, mobile facilities, or educational institutions.

DOT code: Treatment-Plant Instructor*

Noise Control



67

Noise control is a relatively new and growing field, as more people become aware of the need for healthful surroundings. Many of us used to think that a roaring engine, lawnmower, or vacuum cleaner had more power than a quiet one. We have learned that power does not have to chug and clatter.

We know that noise has damaging effects: people become irritable, students have trouble studying, conversation is difficult, and the recuperative value of sleep is interfered with even when sleep is possible. Noise can raise blood pressure, heartbeat, and cholesterol levels. In addition, noise can permanently damage hearing. About 16 million Americans work on jobs where the noise level is so high that their hearing is in danger.[1] Many of these 16 million are exposed to additional noise—from traffic, demolition, and construction—after they leave work.

Loss of hearing often begins with the high-pitched sounds. If you are a victim of noise overdose, you may wonder why bells remain silent and birds no longer sing. You may not hear high-pitched sounds, such as "f," "s," or "th," or you may mix them up. "Fit" may sound like "sit" or "math" like "mass." Not realizing what has happened, you are apt to misunderstand what your friends say. Finally, you may fail to hear a siren or a warning whistle.

Legislation

As we use more and more machines, legal methods are needed to control noise. Community noise ordinances are the oldest type of legal control. An increasing number of cities are adopting them. Nuisance ordinances prohibit certain actions, such as operating construction equipment late at night, driving a car without a muffler, or disturbing neighbors by yelling or playing a radio too loud. Performance ordinances, usually easier to enforce, specify measurable noise limits. An example is zoning, with noise levels, day and night, set for each zoning district, such as residential, commercial, and industrial.

The first national noise legislation was enacted in 1968 when Congress gave the Federal Aviation Administration (FAA) the responsibility for establishing regulations to control aircraft noise, a responsibility this agency still has.

The General Services Administration (sometimes called Uncle Sam's purchasing agent) has issued noise specifications for firms having Government contracts. Violation may result in cancellation of a contract.

The National Environmental Policy Act (NEPA) requires that local and State governments assess the impact that proposed projects, such as highways, airports, and power plants, will have on the environment before they receive any Federal funds. Noise engineers and noise specialists now prepare environmental impact statements, predicting how much a new project will raise the noise level, so that excessive noise can be stopped before it begins.

The 1970 Act establishing the Occupational Safety and Health Administration (OSHA) provides for the setting and enforcement of standards to protect the hearing of workers. However, there has been a delay in the setting of these standards.

The most important noise legislation is probably the Noise Control Act of 1972, as amended by the Quiet Communities Act of 1978, giving the EPA the power to set noise limits for various types of machine equipment. Manufacturers of machines are required to meet the noise standards for their products. Samples of the product are selected off the assembly line and carefully tested under various conditions. Although EPA employees do research (at the noise testing center in Sandusky, Ohio), set standards, and make occasional tests, most of the noise testing is done by engineers and technicians employed by the manufacturers. While some engineers are testing, others are working on the design of new, quieter machines.

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[1] Donna McCord Dickman, "Noise and Its Effects on Human Health and Welfare," *Ear, Nose, and Throat Journal,* January 1977.

Employment

Since noise control is a relatively new field, most of the workers now in it were trained in other fields and have other responsibilities, such as air resources, highway planning, or occupational health. In the future, more workers may specialize in noise control.

It is likely that more audiologists, noise technicians, and hearing-test technicians will be employed when the hearing provisions of the Occupational Safety and Health Act are fully enforced. The greatest number of openings for audiologists will probably be in schools and private practice.

Occupations

Some of the occupations in noise control work are mainly concerned with the engineering or mechanical aspects of projects. For example, noise engineers design quieter machines, highways, railroads, airports, and many other projects. Noise specialists may set noise standards, conduct research, or develop educational programs that contribute to noise control. Noise technicians operate the sound-testing instruments to measure and analyze noise.

Other occupations concentrate on the human aspects of noise. Audiologists conduct programs to save hearing. They identify individuals who have suffered hearing loss and help them deal with it. Audiometrists assist audiologists and physicians in giving routine hearing tests to large numbers of workers, school children, and others.

Audiologist

Audiologists conduct programs to save hearing. They identify individuals who have suffered hearing loss and assist them in dealing with the handicap.

Industrial audiologists conduct programs to save hearing in business or industry. The industrial audiologist supervises audiometrists (hearing-test technicians) and schedules hearing tests for all workers when they are first hired. The workers are then retested periodically. The audiologist follows up with more detailed tests for any worker showing a hearing loss. If the hearing loss was caused by noise on the job, the audiologist notifies the engineering staff or consultants and cooperates with them in finding and controlling the cause.

In addition, the industrial audiologist assists the worker who must deal with a hearing loss. This includes training in attentive hearing, speechreading (lipreading), or in the use of a hearing aid. If a hearing aid can help, the audiologist selects the best type for the particular problem. If there is an ear infection or other condition needing treatment, the audiologist refers the worker to a licensed physician specializing in diseases of the ear—or of the ear, nose, and throat—or to a surgeon if the hearing loss can be corrected surgically.

As experts in the human aspects of noise, some audiologists work for noise control offices of Federal, State, or local government and help in evaluating noise regulations, noise codes, and other control activities.

There are audiologists who are consultants, working with lawyers to help workers collect compensation for damage to their hearing.

Some audiologists are research scientists, studying the effects of noise on hearing and behavior. Others design equipment, teach audiology, or organize programs and prepare exhibits to alert the public to the need for hearing conservation. For one such exhibit, an audiologist designed an "unfair hearing test" to show people what it is like to be hard-of-hearing.

A hearing loss in a child can keep the child from speaking, learning, and relating to other people. Audiologists often work with children to discover and treat hearing problems as early as possible. Because perhaps as many as half of the hard-of-hearing are over 65, audiologists also work with the elderly.

Audiologists need sensitivity, stability, and personal warmth to work with individuals, including the handicapped, and to present hearing conservation plans to workers, employers, and the public.

Job Requirements

The basic requirements for an audiologist are completion of work toward a master's degree in the field, satisfactory performance of a year's supervised professional practice, and the passing of a national certification examination.

The audiologist needs to understand the mechanism of the ear, the nature of sound, and the psychology of communication. Coursework includes speech and hearing science, the physics of sound and electronics, the educational processes of rehabilitation, anatomy, physiology, bioacoustics, and psychoacoustics. Coursework for industrial audiologists needs to include hearing conservation, industrial management, industrial engineering, and industrial psychology.

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Opportunities

Audiologists are needed in the Armed Services (where damage can result from gunfire noise), and in factories, power plants, airports, and mines, as well as rehabilitation centers, psychiatric centers, health departments, community speech and hearing centers, schools, colleges and universities, research laboratories, and in private practice. They are employed in cities, on Indian reservations, in migrant camps, and in economically depressed rural areas.

Some increase in openings for audiologists is expected through the 1980's as a result of an increase in the number of people having hearing problems and Federal and State legislation that provides for hearing services to preschool and school-age children who need them. The greatest number of job openings will probably be in schools and in private practice. However, it is anticipated that more industrial audiologists will be needed, too, the demand depending upon noise regulations prepared by the Occupational Safety and Health Administration (OSHA).

A Ph.D. degree in audiology increases the potential for promotion to jobs in advanced research or in administration.

Source of additional information: American Speech and Hearing Association, 10801 Rockville Pike, Rockville, Maryland 20852.

DOT code: Audiologist	076.101-010

Audiometrist

Audiology aide
Audiometric technician
Hearing conservationist
Hearing-test technician

A first step in hearing conservation programs is the giving of routine hearing tests to large numbers of workers, schoolchildren, or others.

Audiometrists assist audiologists and physicians (such as otologists and otolaryngologists) by giving screening tests to find individuals with hearing loss who need further attention.

Audiometrists need patience and tact in dealing with people, including the handicapped. They must be able to handle delicate testing equipment and record test results legibly and accurately.

Job Requirements

No specific educational background is required of these technicians. They are either trained on the job for 3 to 6 weeks by an audiologist or they are given an intensive 3-day course covering the responsibilities of different workers on the conservation team; the operation, calibration, and care of various instruments for measuring hearing; the selection and fitting of ear protectors (muffs and plugs); and recordkeeping. The course includes an introduction to how we hear and to the principles of noise measurement and control, including legislation, such as State hearing-loss compensation laws and the Federal Occupational Safety and Health Act.

Opportunities

Audiometrists work in schools, industries, the military services, and public hearing-conservation programs.

Openings for full-time audiometrists occur only in very large hearing conservation programs. Usually the duties are carried out by another worker, frequently by an occupational health nurse or a school nurse. In industry, any employee—for example, a clerk in the personnel department—may be trained to do the testing.

DOT code: Audiometrist 078.362-010

Noise Engineer

Acoustical engineer, control

Noise engineers use engineering know-how to protect our hearing by reducing noise from transportation, construction equipment, power plants, factories, and other sources. To do this, they conduct noise surveys (for enforcement and research). First, they choose test sites, set up noise-measuring equipment, and train and supervise the noise technicians who do the testing. Then, using statistical methods and computer processing, noise engineers analyze the information gathered and report their findings.

Engineers help industries solve noise problems by finding the cause of noise and recommending control methods. They examine engineering plans, prepare the noise portions of environmental impact statements, and assist environmental lawyers in writing noise regulations.

Design is an important part of all engineering. Some noise engineers design the electronic instruments used for testing hearing ability and noise levels. Others design noise barriers to absorb or reflect sound waves. Still others attack noise at its source by designing quieter machines.

One engineer, specializing in highway noise, is comparing the noise produced by different types of tires (and treads) on various highway surfaces at different speeds. This engineer hopes to find a way of reducing noise by improving tire design.

Another engineer, working for a large company, travels to plants all over the United States, designing noise-reducing enclosures for machines. Each enclosure is custom built. Openings have to be left for overhead cranes and for conveyor belts, and it must be possible to observe each machine's operation (through rubber-mounted, double-layer, safety-glass windows) and get to the machines quickly in case of an emergency.

Duties of noise engineers are often combined with other environmental protection responsibilities, most commonly air quality. In smaller communities, one environmental or public health engineer may be responsible for controlling air, water, and noise pollution.

Job Requirements

A broad background is recommended for an understanding of acoustics, starting with high school courses in physics, biology, chemistry, and mathematics.

A degree in engineering—civil (highway), electrical, mechanical, aeronautical, or acoustical—or in physics is required. Courses must include acoustics (with laboratory work), mathematics (through calculus), and the physics of materials and of the earth and atmosphere. Courses in light and optics are useful, since many natural laws of light apply to sound. Medicine, physiology, and psychology courses are helpful for understanding the mechanism of hearing and the effects of noise.

Applicants must have or be able to secure a State license as a professional engineer.

Many openings require automobile travel, so a driver's license may be needed.

Noise engineers are trained on the job for 6 months to 2 years. During this time, they attend courses and seminars conducted by various agencies, such as the Federal Highway Administration, and become familiar with the purpose, policies, and currently used materials of the department for which they work.

Opportunities

Noise engineers work for airports, power plants, manufacturers, consulting firms, universities, nonprofit research organizations, and governmental agencies (such as the U.S. Department of Transportation, the Bureau of Mines, the Tennessee Valley Authority, and the Environmental Protection Agency). Openings are most apt to occur in cities or near airports. Announcements and application blanks for Federal jobs are obtained from any Federal Job Information Center or from college placement offices.

Because of the long time it takes to become an engineer, it is difficult for the student to know what the demand for engineers will be at graduation, but there is a need for noise engineers and the demand is expected to increase as people become more aware of the importance of controlling noise. The number of job openings will be affected by general economic conditions, organizational changes in agencies, new regulations (and stricter or more flexible enforcement), and new technologies.

A doctoral degree in engineering or physics increases an applicant's employment prospects in research and development, teaching, and management. An advanced degree in public works administration improves the chances for promotion to an administrative opening.

DOT code: Noise-Abatement Engineer 019.081-018

Noise Specialist

Acoustician, noise control
Environmental-program specialist (noise)
Noise analyst
Noise pollution-control specialist
Noise scientist

Noise specialists use a knowledge of physical, biological, or behavioral science to conduct research, investigations, and educational programs that contribute to noise control. Some travel between work sites, running a noise-sampling network or making a survey of noise sources. Others work in laboratories doing research, for example, on stress symptoms resulting from noise.

After completing a study, the noise specialist analyzes the results, by statistical and computer methods, and uses the results to develop noise-control methods or to set standards for allowable noise levels.

Noise specialists prepare environmental impact statements (predicting the effect a proposed construction project will have on the noise level), assist lawyers in writing regulations to control noise. They may investigate noise complaints, prepare evidence, and testify in court. They write technical reports and educational materials and present information on the why and how of noise control at public meetings.

Since noise control is a relatively new field, public education is a large part of the noise specialist's job. Explaining the health effects of noise has been the most successful method for developing interest in noise regulation.

Noise specialists are expected to communicate and cooperate well with others, have an interest in environmental issues, and be willing to travel.

The noise specialist may concentrate on one area of noise control, such as airport or highway noise abatement. Usually noise control is combined with other environmental concerns, most commonly with air quality. For example, a transportation environmental analyst specializes in the environmental problems caused by transportation, including both air and noise pollution.

Job Requirements

The noise specialist needs 4 years of college-level coursework, with an emphasis on physical, natural, social, or environmental science. Many assignments require graduate study. The major subject may be acoustics, physics, engineering, physiology, biology, public health, mathematics, economics, sociology, psychology, land planning or architecture. University programs specifically designed for a career in environmental noise control are lacking; however, the elements recommended are the following: engineering acoustics (with the mathematical concepts and formulas involved), computer science, environmental planning, the health effects of noise, and the basics of management. Courses in writing, speech, and psychology provide preparation for presenting information convincingly. A knowledge of airport operations or experience as a building inspector can be helpful for some assignments. Work experience may sometimes be substituted for part of the education.

On-the-job training extends over about a year. During this time, the noise specialist learns noise regulations and the principles, practices, and policies of the employing agency.

Opportunities

Noise specialists are scattered in different government departments, such as public health, occupational health, safety, building, zoning, and transportation (including State highway and aeronautics departments, airports, and the Federal Aviation Administration), and in large engineering and architectural firms.

It is anticipated that a growing interest in noise control will result in increased employment of noise specialists. At present, there is a shortage of staff, but openings are limited by a lack of funds. The duties of the noise specialist are usually combined with those of another worker, such as the air scientist.

Opportunities are best for those having advanced degrees and willing to relocate.

DOT code: Environmental Analyst 029.081-010

Noise Technician

Noise inspector

Noise technicians, working in teams of two, operate sound-testing instruments to measure and analyze noise. The data they collect is used for research, for writing environmental impact statements, and for enforcing noise regulations.

Technicians may set up instruments on rooftops near an airport to continuously monitor noise from military aircraft; carry small handheld instruments to answer a complaint about a noisy air conditioner; or drive a van equipped with built-in noise and weather instruments to test noise along a highway. Some check the level of noise that workers are exposed to in factories. Some test manufactured products, such as trucks, snowmobiles, lawnmowers, chain saws, and industrial vacuum cleaners. Others answer complaints about noise and determine whether or not a law is being violated.

Technicians check instruments before and after readings to insure accuracy. They replace batteries and other parts when needed and report out-of-order instruments to the noise engineer.

They listen to noise, first with just their ears, then with electronic instruments. In addition to pitch and loudness, they record the time of day, weather conditions, the noise source, and the distance between the source and the measuring instrument. They also note if the noise is continuous or on and off, if it is heard mainly from one direction, and if there are reflecting walls, sound-absorbing materials, or other structural conditions affecting it. Often one technician takes readings while another records them. Afterwards, both enter the information on charts and graphs.

Noise technicians work for either industry or government. In government, some issue summonses to noise violators and are called noise-control officers or, in the Occupational Safety and Health Administration, compliance officers (C.O.'s).

Noise technicians need good eyesight and hearing. They have to be precise in recording test results and careful in handling delicate and expensive equipment. They must cooperate with other workers in order to work in teams of two. If assigned to answering nuisance complaints, they must exercise tact to settle disputes between neighbors.

Job Requirements

Requirements for noise technicians vary with the complexity of the assignment, but the minimum are graduation from high school, a driver's license, and ability to use arithmetic and draw graphs. An understanding of logarithms is helpful since the decibel scale is logarithmic. State and local government agencies often give new employees a 3- to 5-day intensive course. This course includes an introduction to the physics of sound and hearing (how we hear), noise laws and standards, problems of enforcement, the effects of noise on a community (including interference with sleep and speech), and noise control. The main part of the course covers methods of measuring noise and the care of electronic instruments. Laboratory practice is given in the use of sound-level meters, microphones, tape recorders, and other equipment.

When the course is not available, a new technician is trained on the job by another noise technician or engineer.

When inspecting is an important part of the assignment, workers with experience in other community nuisance-control programs, such as smoke, weed, and litter control, may be retrained to work as noise technicians.

Experience with electronic instruments is preferred, and college courses in physics, mathematics, or engineering improve the chances for employment.

Opportunities

Openings for noise technicians will depend upon enforcement activities of such agencies as the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA), available funds, and public awareness. Currently, more technicians are needed than are employed in industry.

It is recommended that those who want to be technicians expand their opportunities by preparing for a broad base of technical work, rather than by specializing in one field, such as noise.

For promotion to noise engineer, a 4-year college course is required.

DOT code: Pollution-Control Technician	029.261-014

Air Resource Management

Each year in the United States, smokestacks and tailpipes let loose into the air we breathe 200 million tons[1] of fumes and soot. This pollution reduces the distance we can see, corrodes buildings, strips the leaves from plants, burns our eyes, and increases our chances of suffering from lung and heart disease or cancer.

More than 10 times a minute, we cannot keep from inhaling the air, regardless of how contaminated it becomes with such pollutants as sulfur dioxide, carbon monoxide, lead, mercury, arsenic, asbestos, and tiny lung-clinging bits of ash. During one day each of us breathes in about 20 cubic meters of air, enough to fill a room 9 by 10 feet. With this enormous volume of air passing over the absorbent surfaces of our lungs, even a trace of lead or carbon monoxide can result in dangerous bloodstream levels. Other substances, such as particles of asbestos, are not absorbed but pile up on our lungs over a lifetime.

We are now spending billions of dollars on air-pollution control, and there is no way to prevent this expense. If we don't pay to control air pollution, we pay even more in medical bills, lost time, and human suffering.

Legislation

Seventy years ago there were some local "smoke control departments," but activity increased in the 1950's and 1960's when many State and local air pollution programs were organized. With passage of the Clean Air Act of 1970, as amended in 1974 and 1977, States had to develop control programs to meet Federal air quality standards.

Employment

Legislation and environmental protection programs—Federal, State, and local—have resulted in the formation of a new, rapidly expanding industry, the manufacture of pollution-control equipment, an industry that is creating new manufacturing jobs.

Every year a thousand or more[2] new industrial chemicals are developed. Some of these enter the air as pollutants and are found to be toxic. Engineers are needed to design instruments for detecting pollutants and methods for controlling them.

The air-quality field is sometimes called top-heavy because about 60 percent of the workers are in professional, technical, and managerial work. Engineers form the largest occupational group. Inspectors and technicians follow next, with smaller numbers of chemists, meteorologists, other scientists, and biometricians.[3]

Growing numbers of women and minority group members are becoming interested in engineering and increasing numbers of them will be finding careers in air resource management.

In the future there will be more extensive use of remote-control electronic devices for automatic around-the-clock recording of air quality. New methods may be found to "fingerprint" pollutants, identifying them and tracing them to their sources so that the offenders can be prosecuted. Testing of the air people actually breathe while on the move during a day will be used increasingly to supplement tests at set locations. Groups of people, such as school children, factory workers, and traffic-patrol officers, will be asked to wear small electronic devices to register the total amount of air pollution they are exposed to during a day.

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[1] *Choose a Career Which Allows a Future: Professional Career Opportunities with U.S. Environmental Protection Agency* (Washington: U.S. Environmental Protection Agency, 1976), p. 8.

[2] Richard Lyons, "Chemicals in Search of a Solution," *The New York Times*, December 25, 1977, p. 6E.

[3] *Analytical Studies for U.S. Environmental Protection Agency*, Vol. V: *Manpower for Environmental Pollution Control* (Washington: National Academy of Sciences, 1977), pp. 361, 370.

The greatest change in the future is apt to be an increasing use of solar energy, a fuel which does not pollute the air as present fuels do.

Occupations

Occupations in air resource management include air engineers who design and construct many projects affecting our air. They often work with air scientists, meteorologists, and chemists who use their scientific knowledge to find ways to improve the air.

In addition, many technicians assist the professionals in data collection and routine testing. For example, the biometrician plays an important role in advising scientists on the use of statistical methods. In laboratories, chemists may be assisted by technicians and aides.

Air Chemist

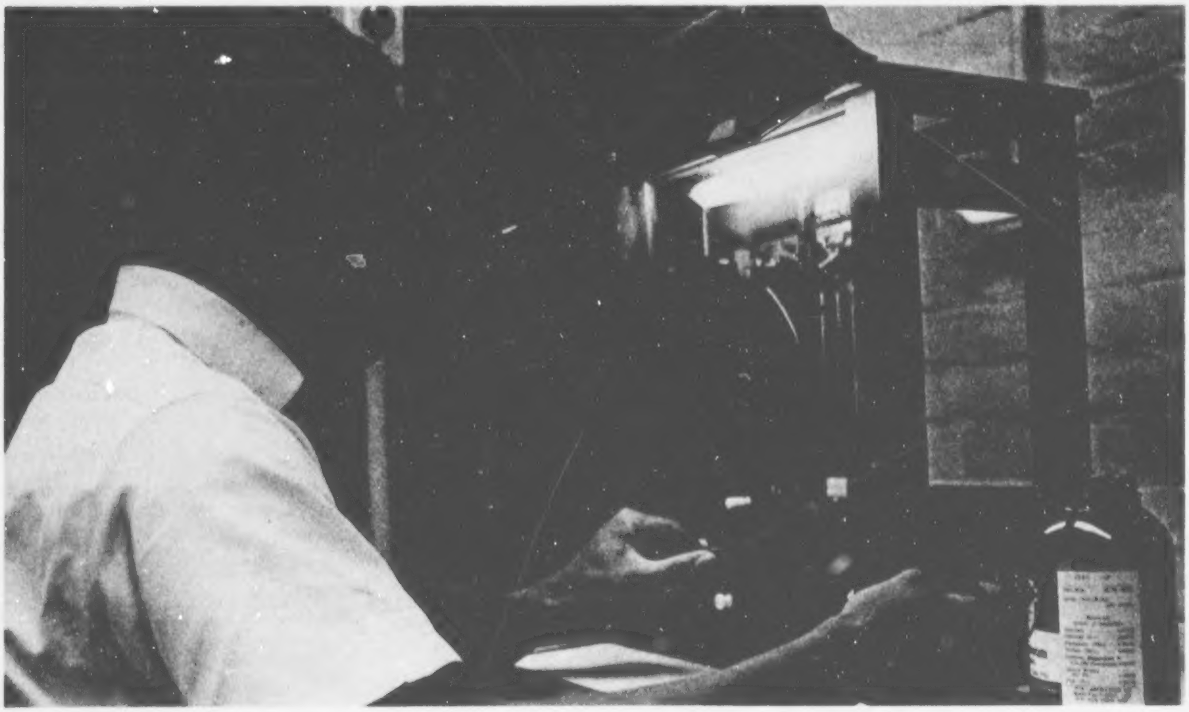
Chemist
Environmental chemist

Air chemists use their knowledge of chemical reactions to identify pollutants in the air and their effects on the environment. They utilize simple routine tests for common pollutants; but, when necessary, they also make a more detailed analysis of substances filtered from air, smokestacks, or exhaust pipes.

To analyze a sample, the chemist uses a series of tests. Each test eliminates a group of possibilities and helps decide what the next test will be until an ingredient is pinpointed. The chemist then determines, not only what substances are in the sample, but how much of each, using special scales, which even a touch can upset because of oil and moisture on the hands.

The pollutants in the air are not just the sum of all the dust, smoke, fumes, and gases released, but also include substances created by the interaction of original pollutants in the presence of moisture or sunlight (or varying combinations of moisture and sunlight) forming acids or photochemical smog. Smog may be more dangerous than the original pollutants. All the chemistry of smog and acid formation is not fully understood, so some chemists are assigned the job of finding out exactly what happens when various chemicals mix in the presence of moist air and sunshine.

Others investigate the effects of different pollutants on construction materials and on living tissue, using their knowledge of how chemicals interact. Still others develop simple inexpensive tests that can be done routinely for common pollutants, study the effect of different pollutants on visibility, find out how pollution from supersonic airplanes is changing the earth's climate, or trace pollutants to the industrial plants from which they come by examining them microscopically.



Air chemists set up complex equipment. They train and supervise laboratory technicians in the running of routine tests. They act as chemical consultants to other workers, such as air engineers; write technical reports on the results of their work; read publications on chemistry and meet with other scientists and engineers to keep up with new developments in their field.

Job Requirements

The chemist needs a college degree, with a major in chemistry or a related field, with at least 24 semester hours of chemistry (30 hours for Federal jobs). Courses should include quantitative analysis; inorganic, organic, and physical chemistry; physics; biology; and mathematics (algebra and calculus). An advanced degree—usually a Ph.D.—is required for most research assignments.

Applicants for government jobs apply at city, county, State, and Federal civil service offices. A written exam is usually given.

Air chemists are trained on the job for a year, while they learn State and Federal clean-air regulations and become familiar with methods for applying chemistry to pollution problems.

Opportunities

Air chemists are employed by government agencies, by industries having air-pollution problems, by private consulting firms advising industries, and by colleges, universities, and nonprofit research organizations.

Although there are job openings for chemists, there are not many opportunities to specialize in air quality. Because rain carries chemicals from the air to the soil and on to streams and lakes, air pollutants are often problems in soil and water as well. Most pollution-control chemists do not specialize in air, water, or soil, but analyze samples and work on pollution problems anywhere in the environment.

Some organizations hire only one chemist at a location. In larger organizations, there can be a possibility of advancement to chief of a chemical laboratory.

DOT code: Chemist, Pollution Control 022.061-010

Air Engineer

Air-management engineer
Air-pollution-control engineer
Air-quality engineer
Air-resource engineer
Air-sanitation engineer

Air engineers use engineering know-how to keep the air fit to breathe. All engineers are problem solvers. Problems are assigned to them, but the choice of techniques and interpretation of results is up to them. They decide where and how often air testing should be done, set up equipment, and train air technicians to run tests. They collect all the test results for computer processing, analyze the findings, and report their recommendations. Reporting may take the forms of a letter, a technical article, a news release, a speech.

Some engineers are assigned to seek out sources of pollution and find ways to control them. A map is drawn to show all the important pollution sources in an area. An engineer visits the industries on the map, inspects their control equipment, and suggests improvements. If regulations are being violated, an agreement is reached with management on steps to correct the condition and a deadline is set. When necessary, the engineer collects evidence, such as test results and photographs, for testimony in court.

To prevent new pollution, plans for construction that may add pollutants to the air are first analyzed by air engineers. Only engineers can approve, reject, or recommend changes in engineering plans. Studying the plans, along with information on wind direction, climate, population, traffic, housing, types of fuel used, and the contours of surrounding land, makes it possible to predict how much new pollution will result from the building of a powerplant, highway, or papermill. Engineers then recommend whether or not construction should begin.

An important part of engineering is design. Some air engineers design and test different types of barriers to help keep car exhaust away from houses near highways. Others design instruments for testing the air or devices for controlling pollution, such as fabric bags that filter smoke, scrubbers that wash stack fumes with water, or electroprecipitators that use an electric charge to remove the fine ash that results when crushed fuel is burned in power stations.

There are other engineers who, instead of working on air cleanup, stop pollution at its sources by developing new industrial processes, finding methods for removing sulfur from coal, or designing engines that use new kinds of power.

Air engineers make important decisions, such as what to do when a dangerous chemical is spilled. Ordinarily they work regular hours, but they are on call when there is an emergency, such as a plant breakdown, a buildup of pollutants in stagnant air, or a train wreck releasing poisonous gas into the atmosphere.

They keep up with new discoveries by reading literature in the field and by meeting with other engineers and scientists. They are expected to know how to use a library to look up information, how to use a computer and statistics in research, and how to draw graphs and maps.

They are expected to answer questions the public may have about air quality and to help in educational projects. For example, since fuel burning is a major cause of air pollution, an air engineer may conduct a program to encourage the use of solar energy.

Air engineers must speak and write effectively. They have to be tactful, firm, and impartial in dealing with a wide variety of people, including contractors, plant managers, and attorneys. It is not easy to tell a contractor that carefully made plans have to be changed to prevent air pollution.

Air engineers usually travel within an assigned area. There is some exposure to chemicals, fumes, dirt, dust, noise, extremes of weather and temperature, and occasional climbing and lifting.

Job Requirements

The basic requirement for work as an air engineer is a bachelor's degree in some branch of engineering, such as sanitary, civil, chemical, mechanical, electrical, industrial, or public health. The degree should be from a college or university accredited by the Engineer's Council for Professional Development; registration or certification as a professional engineer (with the local State Board of Professional Engineers) is necessary. Students are not expected to specialize in air quality until after graduation.

The engineer needs mathematics, including calculus, and some science courses. Particularly helpful are courses in physics, chemistry, biology, physiology, toxicology, and meteorology.

A driver's license is needed for travel between sites. Industrial employers may require some experience in their particular industry, such as pulp and paper or automobile manufacture.

For government jobs, a civil service exam is usually required. Application is made to the civil service offices of the various levels of government and to the nearest regional office of the U.S. Environmental Protection Agency (EPA).

Air engineers are trained on the job for 6 months to 2 years. During that time, they become skilled in methods of measuring and controlling air pollution. They learn about the nature and extent of pollutants and the processes that produce them—industrial operations, stationary and mobile combustion sources, and community wide sources, such as automobiles, home heating, and drycleaning—as well as the economic, environmental, and health effects of such pollutants. They also become familiar with Federal, State, and local air-pollution laws and regulations.

Opportunities

Air engineers work for city, county, State, and Federal agencies; for industries that have air-pollution problems, such as chemical plants, petroleum refineries, electric power plants, steel mills, and foundries; and for private consulting firms. Pay is usually higher in private industry than in government.

The names vary across the country, but some of the State agencies that employ air engineers are the departments of environmental quality, transportation, health, and natural resources. The U.S. Environmental Protection Agency also has research centers and 10 regional offices.

New air regulations have created a demand for air engineers, who make it possible for industries to meet the new requirements. There are opportunities for air engineers in industry, in government, and in consulting companies. The largest firms hire their own air engineers. Smaller firms rely on either government agencies or private consultants specializing in environmental engineering.

Engineers are often assigned to a series of projects, occasionally acting as project leaders. Experience as a project leader gives an engineer an opportunity to develop and demonstrate management ability. A small number of exceptional engineers are promoted, after several years of experience, to chief engineer, as openings occur. A chief engineer may be assigned a geographical area and is sometimes responsible for water quality as well as air quality.

DOT code: Air-Pollution Engineer 019.081-018

Air Scientist

Air-quality specialist
Air resources scientist
Environmental analyst (air)
Environmental program specialist (air)

Air scientists, with different specialties in the physical and life sciences, use their scientific knowledge to find ways of improving the air we breathe. Field studies to detect and analyze pollution are a basic part of the work. Studies include inspecting and testing sources of pollution, such as smokestack and car exhaust, and testing the quality of ambient air (the ocean of air surrounding us). Samples of soil, water, vegetation, or materials affected by air pollution may also be tested. Information collected in the field provides data for research studies and is used to enforce air quality regulations, check the effectiveness of control methods, and warn of hazardous conditions.

After completing a study, the scientist recommends changes in activities to control pollution and prepares a technical report. The report may include charts, maps, and an analysis of what new control methods would cost.

Air scientists give scientific advice on air-pollution problems to government officials and plant superintendents, investigate complaints of injury to plants or animals caused by toxic substances in the air, explain air-pollution laws and regulations, and give talks to civic groups. They assist in preparing environmental impact statements, predicting the effect that newly proposed projects, such as highways or powerplants, may have on air quality, and comparing the end results that might be expected from alternate projects.

To discover which pollutants are dangerous to breathe and in what amounts, scientists conduct research on animals or analyze medical findings and statistics to discover what different contaminants do to human health. When cancer or heart or lung disease is reported more frequently in one State than others, air scientists may be assigned to help discover why. Other scientists study the effects of carbon monoxide on the nervous system or on behavior; find out how much cigarette smoking increases asbestos damage to the lungs; trace vaporized cadmium as it spreads from the air to land, water, and food crops; or investigate birth defects resulting from air pollution.

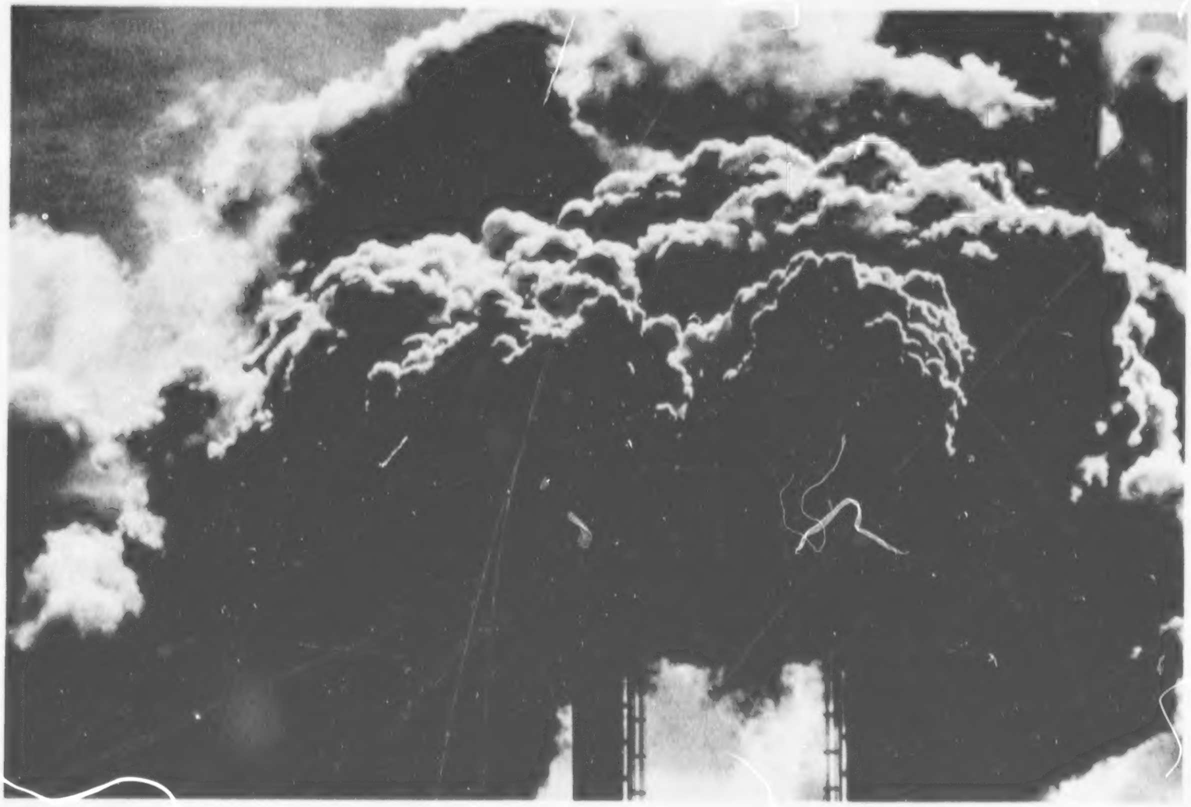
Instead of studying the effects of pollutants on people, some scientists study their effects on crops, trees, and farm animals or on materials such as metal, paint, rubber, and fabric.

Scientists are assigned problems, but the methods for solving the problems and the interpretation of the results are left up to them. In any research, statistical methods are necessary, both in planning the study and in interpreting the results. By using computers, scientists are able to deal with more information than was formerly possible.

Scientists help develop policies, collect evidence against polluters, appear as witnesses in court, and assist in preparing proposals asking for Federal grants to pay for research. They may travel to different work sites, often throughout a State. They are expected to keep up with current trends, have practical ideas and express them clearly—orally and in writing—and cooperate with coworkers. They need good eyesight, good speaking and hearing ability, and the ability to lift up to 5 pounds and occasionally over 15 pounds of equipment.

Job Requirements

Different assignments call for different preparation, but the minimum requirement for an air scientist is a 4-year degree in one of the sciences (such as biochemistry, physics, geophysics, or biology) or in engineering, mathematics, environmental health, industrial hygiene, public health or sanitation. Regardless of their major, air scientists need to know something about chemistry, physics, meteorology,



and biology as they relate to air sanitation; the chemical and physical characteristics of air impurities and their effects on human health; and how these effects can be changed by weather. Air scientists also need a knowledge of the analytical procedures used in biological and chemical tests (including the uses of such instruments as microscopes, pH meters, and microtomes), computer science, and methods of statistical analysis. Courses in public administration, sociology, economics, and environmental or urban studies are desirable. Industrial experience or knowledge of industrial processes is helpful: for example, testing, inspecting, or maintaining automobile engines is valuable experience for an assignment in the automobile industry. Advanced degrees—usually a Ph.D. for research—are now required for many assignments.

In a year or more of on-the-job training, air scientists become familiar with technical developments in air-pollution control, along with the legal problems involved in enforcing laws and regulations. The training includes a 5-day course in visible-emission evaluation (estimating how dense industrial smoke is by comparing it with a density chart).

Opportunities

Air scientists work for Federal, State, and local departments of government (transportation, health, and environmental protection), industries that discharge pollutants into the air (and need help with control methods), and private consulting firms. A few work for private organizations advocating clean air.

Among 4-year graduates, opportunities are best for majors in engineering or physical science. A person majoring in biology may need an advanced degree to find work as an air scientist. The employment outlook depends upon public awareness of the importance of clean air and the availability of funds for air quality control and research.

Opportunities for the more responsible assignments and for promotion are better with advanced degrees.

DOT code: Air Pollution Analyst 029.081-010

Air Technician

Air-monitoring technician
Air-pollution-control inspector
Air-quality technician
Air-sampling technician

Air technicians collect samples of outdoor air or of pollutants, such as fumes or dust entering the air. They do routine tests on the samples, using special measuring instruments; record the amount of pollutants; and supply this information, often in graph form, to an engineer. Because tubing inside instruments stretches, lights dim, and chemicals weaken, technicians frequently calibrate or check measuring instruments to be sure they are reading correctly.

Some technicians keep watch on pollution sources, either inspecting smoke-control equipment in factories and observing the density of smoke plumes or testing the engine exhaust from cars and trucks.

Some air technicians operate vans equipped with built-in electronic instruments and investigate air-pollution complaints or use the same vans to gather information on air-pollution in traffic.

Other technicians, instead of watching pollution sources, test the quality of the outdoor air we breathe. A technician assigned a route of rooftop instruments drives between worksites and climbs stairs and ladders to adjust equipment on wind-swept roofs, read instruments, and collect samples.

Other technicians maintain continuously run electronic equipment set up in stationary housetrailers. In each trailer a vacuum pump pulls outdoor air, 24 hours a day, through a glass pipe running the length of the trailer. There are outlets along the pipe to supply air for the various tests being run. Air bubbles through chemical solutions that change color if sulfur dioxide or nitrogen dioxide are present, and a colorimeter measures the color changes. Particles settling out of the air make soiled spots on a moving strip of filter paper, and a photometer measures light passing through the spots to determine their density. There are other instruments to measure other pollutants; and, since weather affects pollution, weather instruments are installed on the roof of the trailer.

All the instruments can be connected to recording devices that automatically graph measurements on 30-day rolls of paper, or they may be connected to a data averager that compiles and averages the information and supplies it every 15 minutes to a centralized computer.

The technician replaces chemicals and worn tubing, checks to see that all units are operating, calibrates by testing the instruments with samples of known composition, and records results. If an instrument needs repair the technician removes the unit.

For any assignment, the air technician drives a car or van to travel between test sites. Technicians need to know something about both mechanical and electrical work, enough about electronics to remove the right part for replacement, and enough mathematics to draw graphs and use mathematical formulas. Accuracy in reading data and a legible handwriting are necessary.

Work may include working next to moving machinery, adjusting equipment outdoors in freezing weather or indoors in boiler rooms, and lifting bottles of chemicals. There may be exposure to fumes when testing pollution sources, and noise may exceed safe limits. Specially designed ear muffs are worn to protect the hearing of the worker testing cars.

The work is routine because tests must be run thousands of times in exactly the same manner. However, new procedures and new instruments are often developed.

On some assignments the technician has opportunities to introduce ideas for improving equipment and may be able to use special skills, for example, skill in sheet metal work for building covers for instruments, or in photography, recording factory smoke plumes, damage to trees, or other evidences of pollution.

Job Requirements

Air technicians are usually required to have either 2 years of college-level technical education or technical experience. The education may be in technical school or in college, with such courses as engineering, physical science, and mathematics. Practical experience may be in either analytical laboratory or mechanical and electrical work. Particularly desirable is experience with instrumentation or with fuel-burning engines, such as automobiles, motorcycles, or industrial fuel-burning devices. Practice in using minicomputers would be helpful. A driver's license is required.

Applicants for government jobs apply at city, county, State, and Federal civil service offices. There is usually a practical written test, which may include questions on air-pollution-control regulations. Information on what a test covers can be obtained at the civil service office.

Air technicians are trained on the job for about 6 months. The training includes a few days learning how to observe smoke density.

Opportunities

Air technicians are employed by government—city, county, State, and Federal—in health, environmental, and transportation or traffic departments. They are also employed by private engineering consultants specializing in environmental problems and by large industries with pollution

Bacteria
Stud

problems, such as chemical plants, powerplants, refineries, papermills, cement plants, metal processors, and automobile manufacturers.

Employment is scattered. One State air-resource agency, for example, has only 10 air technicians, yet another has about 80; a large paper manufacturer has 2. As openings may be limited, it is recommended that anyone interested apply at more than one place and also consider other types of technical work (including water-pollution control).

For promotion, a 4-year college degree with a major in engineering or physical science is usually necessary.

DOT code: Pollution Control Technician 029.261-014

Air Technician, Meteorology

Meteorological technician

A few air technicians are assigned to assist the meteorologists who forecast air-pollution levels. These technicians observe sky and visibility conditions, read weather instruments, receive weather information from teletype and facsimile machines, perform mathematical calculations (to determine, for example, the average wind speed), get data ready for keypunch operators, and enter information on graphs and maps (for example, maps to show wind direction and the heights of hills and smokestacks).

Technicians measure and record temperature, pressure, humidity, wind speed and direction, and precipitation. They wire, set up, clean, and calibrate weather instruments. To get information on the upper layers of air, they float balloons equipped with miniature radio transmitters, record information transmitted as "bleeps," and calculate the height of the balloons, using the triangulation method and trigonometry tables.

Most of the work is indoors, preparing graphs and maps and posting data or performing mathematical calculations. However, part of the work is outdoors. Technicians travel in all kinds of weather to test sites to check equipment and take readings.

Weather instruments weighing about 30 pounds are set up on 10-foot tripods located in various places, such as rooftops, trailer tops, or ski-lift pylons. Usually a meteorologist and a technician work together to install equipment.

Job Requirements

The technician is required to have either related education or experience. The education may be 2 years of technical training or an associate degree in engineering, mathematics, or physics. Work experience using scientific instruments—for example, as an engineering technician—may be substituted for the education. A driver's license is needed.

On-the-job training in weather information and instrumentation lasts about 6 months.

Opportunities

A limited number of technicians are hired to assist the meteorologists who predict air pollution. More are hired (by weather departments) to asist less specialized meteorologists who predict the weather.

Promotion to meteorologist requires a 4- to 5-year college course.

DOT code: Weather Observer 025.267-014

Biometrician

Biostatistician

Biometricians advise air scientists and others on the use of statistical methods, both in planning research and in interpreting the results.

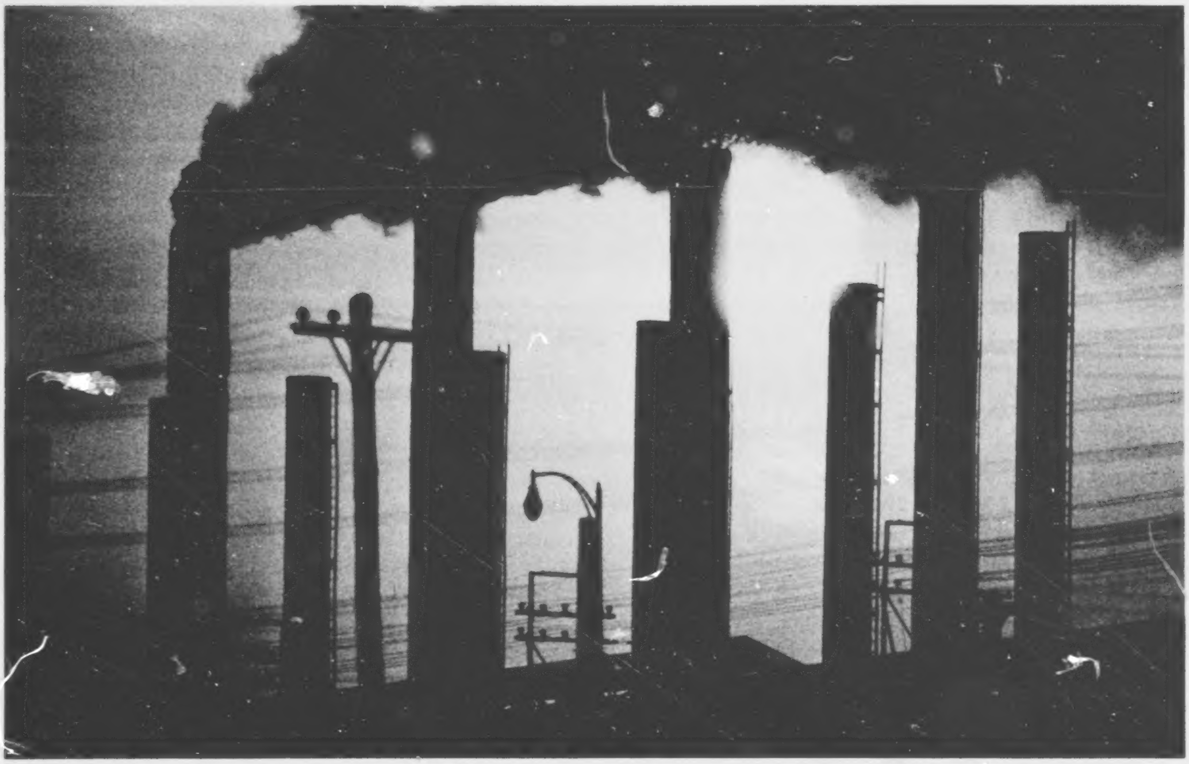
How can one be sure that a sample of the air or of the population for example, is representative? How many measurements must be taken to obtain reliable results? How much error can be expected in a study? These are some of the questions biometricians answer for research workers.

For example, one biometrician is helping an air scientist compare figures on the number and severity of brown lung disease cases with the amount of cotton dust found in the air. Another is helping interpret experiments on mouse embryos to determine which air pollutants, or conbination of pollutants, cause birth defects. An industrial hygienist has discovered that employees of one factory have a higher rate of cancer than is found in the general population; a biometrician will help decide whether the higher rate is significant or due to chance.

A large amount of test data is collected on air pollution and other conditions. Biometricians or other statisticians are needed at times to assist in planning research, preparing data for computer analysis, and interpreting results.

Job Requirements

The minimum requirement for biometricians is 4 years of college. Students either major in biology and minor in statistics or major in statistics and minor in biology. Because mathematics courses have to be taken before statistics courses, students planning graduate study often wait until after graduation to study statistics. The required courses are biological science or medicine, mathematics (through calculus), statistical methods, probability theory, and computer uses. Courses in engineering, physics, chemistry, meteorology, economics, or sociology are helpful for other environmental applications of statistical methods.



Opportunities

Biometricians work for health and environmental protection agencies (Federal, State, and local), utilities, manufacturers, consulting firms, universities, medical schools, voluntary health agencies, and scientific research institutions. Most work near large cities.

They are needed wherever there is research into the effects of air pollution. Public concern about the environment and the availability of funds for research largely determine how much research is done.

Promotion may require an advanced degree. Biometricians may advance to supervisory positions in statistics or they may become research scientists.

DOT code: Statistician, Applied 020.167-026

Meteorologist, Air Quality

Air-pollution meteorologist

Air-pollution meteorology is a field that has developed extensively during recent years owing to increased concern over air pollution and its effects on the environment.

Meteorologists with specialized training in this field are making important contributions to an understanding of how pollutants are carried, spread, and accumulated in high concentrations in the atmosphere. Their expertise is needed to warn the public of possible changes in pollution levels. In order to improve methods for predicting air quality, they analyze the relationships between weather and pollution, using statistical methods.

The air pollution meteorologist relies upon a great deal of meteorological data provided by the National Weather Service, which measures conditions such as wind, pressure, and precipitation throughout the country and sends information out by way of a teletype and radio network. The weather service maintains a continuous watch on meteorological conditions in order to advise the pollution-control agencies and the public of a possibly harmful situation.

Using information from the weather service, combined with measurements of pollutant concentrations, control agencies are able to protect the public by taking action to reduce or, at least, prevent further increase in pollution. Emergency actions may include reducing the operations of powerplants, reducing or shutting down the operations of industry, and closing highways to traffic.

Routine daily measurements are made by many State and municipal agencies and even some private consulting firms. Many agencies issue a "Pollutant Standards Index" (PSI) and forecast which informs the public of existing pollutant levels and what changes to expect. Such information is particularly helpful to people with heart and lung disease.

What is happening in the high atmosphere is very important to the air-pollution meteorologist. This type of data is obtained by releasing helium-filled ballons carrying instruments that measure weather conditions. The weather data is transmitted by radio to a ground receiver at regular intervals as the balloons rise.

Many special field programs are conducted to investigate the effects of different weather conditions on the distribution of pollutants in the air. The air-pollution meteorologist is one of the main participants in these programs.

First, instruments and equipment are selected and installed. Meteorological towers are frequently used. These are steel frames that range in height from 10 to several hundred meters, with weather instruments attached at selected levels.

Field programs are conducted to discover the behavior of plumes (streams of smoke from smokestacks and other sources) and to study how wind flows around buildings and mountains, through valleys, and along shorelines.

A plume from a tall stack can be level at one height, well contained in form, and extend a great distance downwind. At another time, the same plume can take the form of a large, looping streamer with rapid upward and downward movement. The flow of wind about a building or in the vicinity of a large, high ridge can cause pollutants to collect in one area while being vigorously dispersed in another. It is important for the air-pollution meteorologist to understand thoroughly the ways in which these different phenomena affect pollutant concentrations.

Field programs are usually very costly and take a great deal of time. The meteorologist often makes a model for use in a wind tunnel as an alternative to actual field programs. This procedure has provided very successful results.

Another procedure used even more frequently by the air-pollution meteorologist is mathematical modeling. The emissions of pollutants and the atmospheric processes are simulated by complex mathematical equations, which are solved by computer. For this purpose, the meteorologist must have a good background in mathematics and computer technology.

Mathematical or simulation modeling provides the meteorologist with a tool to make estimates of pollutant concentrations from new sources of emissions, control strategies, and population growth. Such estimates are necessary for the management of the air resources to protect the health and welfare of the public.

Meteorologists on an air-quality team are expected to advise other scientists and engineers on problems involving weather or climate. They recommend sites for air-quality measuring instruments. They advise on the best locations for powerplants or industrial parks and help in preparing environmental impact statements, predicting how proposed projects will affect air quality.

They are expected to keep up with new trends in forecasting weather and air pollution, and they need the ability to express themselves clearly, both directly and in writing. They work mostly indoors, analyzing data and preparing reports, but they also travel to test sites in all kinds of weather, carry equipment, and climb ladders to reach weather instruments.

Job Requirements

Meteorologists need a bachelor's degree in meteorology, engineering, physics, or chemistry with coursework in meteorology, climatology, fluid dynamics, thermodynamics, and advanced mathematics (including calculus). To specialize in air quality, there may be an additional requirement, such as a year of graduate study or work experience in meteorology and air-quality control. Some college students obtain experience in meteorology before graduation by working for the National Oceanic and Atmospheric Administration (NOAA) part of a school year.

Meteorologists specializing in air quality are trained on the job for 1 to 2 years, learning applications of weather science to the problems of air pollution.

Opportunities

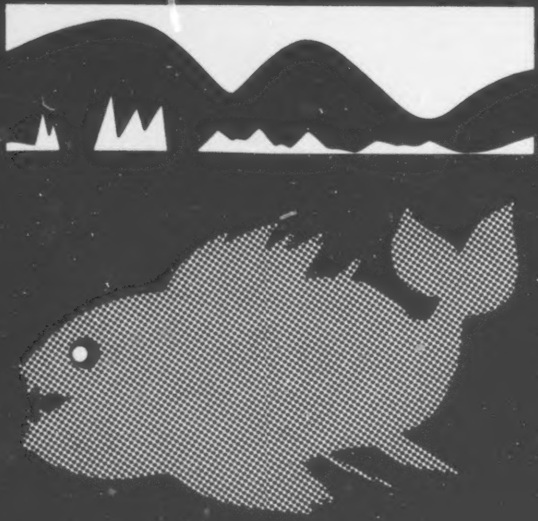
Air-quality meteorologists work for large industries (such as chemical plants, petroleum refineries, natural gas companies, and powerplants), universities, government environmental agencies, and private consulting services.

Because of the effects weather has on air pollution, there is an increasing demand for meteorologists to work in the air-quality field. Openings are scattered, and opportunities are best for those willing to relocate.

Promotion to chief meteorologist is possible after several years of experience. Graduate study helps in obtaining administrative work and research assignments.

DOT code: Meteorologist 025.062-010

Land, Fish, and Wildlife Management



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Either the civilized and natural worlds learn to live together or they will perish separately.

—Henry David Thoreau

Workers in land, fish, and animal management help us use our natural resources without destroying them. If trees are cut, other trees are planted. Streams are restocked with fish. If a meadow is used for grazing, the number of animals on the land is controlled so that plants are not trampled until nothing will grow.

For many years we took our environment for granted. There was what seemed an endless supply of trees, grass, and wildlife (including great herds of buffalo). The lakes, not to mention the ocean, seemed too vast ever to be polluted. Rainwater was pure. Nature was a limitless store of treasures to be found and raided. Recently we have begun to realize that resources can run out. There is no bottomless pit of coal or oil. The ocean is not too vast to become polluted. Rain alone cannot purify our contaminated air. We are in danger of making our planet too poisoned, too exhausted to support human life, in danger of leaving a dust bowl for future generations.

Animals, like people, need an environment in which to live, a habitat supplying food and shelter. When a forest or stream is destroyed, the animals that naturally live in it are destroyed too, and we lose another natural resource.

There are about a million forms of life that we know and maybe 10 million forms not yet studied. There are animals at the bottom of the ocean, in hot springs, and in caves. Some may become extinct before we get a chance to learn anything about them. Once a species is lost, it is lost forever.

It is impossible to say that any form of life is useless. Plants and animals depend upon each other in a complex web of relationships. When one plant or animal becomes extinct, others are affected. We cannot be sure which species may be needed for our own survival. Any species may hold clues that will help us learn how to prevent deseases, such as cancer. Who could have guessed that a blue mold would produce the life-saving drug, penicillin?

Legislation

What are we doing to save our land, fish, and wildlife? Perhaps the first step was made over a hundred years ago with the establishment of Yellowstone Park, the beginning of our National Park System. The Forest Service was organized in 1905. The Fish and Wildlife Coordination Act of 1934 provides that surrounding land be bought for protection of wildlife when an area has to be flooded.

More legislation was passed in the 1970's: The National Environmental Policy Act requires environmental impact statements on projects that affect "the quality of the human environment" so that alternate plans can be considered. The Coastal Zone Management Act offers financial aid to States so that they can develop coastal management programs. The Ocean Dumping Act is phasing out offshore waste disposal. The Endangered Species Act attempts to save animals likely to become extinct. The Federal Surface Mining and Reclamation Act of 1977 sets up an Office of Surface Mining in the U.S. Department of the Interior to regulate the strip mining of coal.

But the greatest environmental decision of our century may come out of the fight over public land in Alaska, our last frontier. Will there be a plan for long-range, continuing use of the land for many purposes? Or will the rich, natural resources be wasted in a race to use them? What will happen to the caribou herds and polar bears when their habitats are destroyed by pipelines, highways, and mining towns? How much land will be left as wilderness?

Employment

Foresters, wildlife biologists, fish biologists, park rangers, conservation officers, and land planners have the complicated responsibility of saving natural resources while still making it possible to use and enjoy them

Occupations in land, fish, and animal management once thought of as jobs for men are now open to women as well. Many women, for example, are now enrolled in forestry courses, and it is no longer unusual to see women working as park rangers.

Job openings for most of these occupations, however, are limited and competitive. At the technician level some of the openings are temporary or seasonal and, because there is a shortage of openings for foresters, technicians must compete with foresters for technicians openings. Even for professionals, such as biologists, openings are few.

Occupations

Occupations in land, fish, and animal management include land planners who study the land, its soil, water wildlife, and other features to develop the land with minimal damage to the environment. Landscape architects design projects.

Conservation officers patrol fish and wildlife areas to protect our natural resources. Park rangers work along with them to patrol and maintain the park facilities, and explain activities to visitors. Foresters manage forest lands, both public and private, and are often assisted by forest technicians who perform a wide range of duties in tree planting, fire prevention and control, road construction, and many other activities. Wildlife biologists specialize in studying birds and wildlife and the effects of pollutants on them.

Fish biologists promote the growth and reproduction of fish in nature and in hatcheries. These professionals often concentrate on research, or they may hold administrative positions. The day-to-day operations of fish hatcheries are usually supervised by fish culturists.

Conservation Officer

Game and fish protector
Natural-resource officer
Special agent (wildlife)

Conservation officers patrol fish and wildlife areas to protect natural resources so that people have an opportunity to enjoy them. They travel over a large area on foot, by patrol car, motorboat, or sometimes by airplane. Emphasis is on voluntary compliance, and much effort is spent on educational activities, explaining laws to visitors and giving talks to groups.

Conservation officers enforce laws pertaining to automobiles, motorboats, water pollution, noise, and fire control in addition to hunting and fishing laws. In some States they are unarmed. In other States they qualify as peace officers, carry a revolver, and have authority to enforce laws.

Conservation officers check fishing and hunting licenses; investigate illegal burning, boating and hunting accidents, and reports of dogs chasing deer. They give first aid to accident victims.

On marine assignments, they patrol shellfish areas and board commercial fishing and lobster boats to inspect for violations.

They may assist fish and wildlife biologists by collecting information on the presence of food and cover (bushes for shelter), reporting when winter feeding is necessary. They may plant food patches for wildlife or assist a biologist in a fish census or an animal rescue operation.

The conservation officer wears a uniform and wading boots, carries a walkie-talkie and binoculars, and may use a camera to record evidence for use in court. On call 24 hours a day, 7 days a week, for emergencies, the conservation officer is expected to work during peak visitor hours, such as weekends. Because waterfowl hunting is busiest at dawn, racoons are hunted in the late evening, and deer poaching is done after midnight, conservation officers often work a split shift.

They must be able to deal effectively with people, communicate clearly, and write accurate reports.

Working as a conservation officer is hazardous. During the deer-hunting season, these officers go alone into isolated woods to confront poachers, who are armed.

Job Requirements

High school graduation is required plus either experience or education in law enforcement, farming, or resource management. The experience-or-education requirement may be met by 2 to 4 years' work in wildlife conservation, game breeding, forestry, fish culture, or commercial fishing; or a 2-to-4-year, college-level course in law enforcement, natural resources, or biology.

As requirements vary from State to State, it is necessary to check with an office of the State civil service commission.

Applicants must be at least 21 years old (age requirements vary with the State), in good physical condition, and have a driver's license. They may be expected to know how to maintain equipment, such as a boat, auto-boat trailer, two-way radio, and firearms. A commercial pilot license is necessary for some assignments.

Opportunities

Most conservation officers work for State conservation departments. States usually hire residents familiar with local conditions and animals. A smaller number work for the U.S. Fish and Wildlife Service. Federal empoyees may be required to relocate outside the State.

Openings are limited. Future hiring levels with the U.S. Fish and Wildlife Service are expected to be low. It is wise, therefore, to check on what local prospects are before planning on this career.

With additional experience or education, promotion is possible to supervision of conservation officers.

DOT code: Fish and Game Warden 379.167-010

Fish Biologist

Fishery biologist
Fish specialist

Fish biologists promote the growth and reproduction of fish in nature and in hatcheries. At one time, the main activity of the fish biologist was the restocking of lakes and streams. Now, it is improving and protecting habitats so that fish have a place to live. The fish biologist samples and tests water, looking for sources of pollution and for sites where fish can safely live and grow.

To study a lake, the biologist first goes out in a boat, drops a weighted line to measure the depth, and draws a bottom contour map, showing the depth at different locations. From this, the volume of water in the lake is calculated. The biologist then uses a net to collect samples of the fish population. From the samples, using statistical methods, it is possible to estimate how many fish are in the lake and prepare growth curves for the different species collected. Sample fish are dissected, the stomach contents analyzed, and any parasites present identified. The biologist collects samples, too, of aquatic insects and bottom organisms that fish eat. Using all the information gathered, the biologist makes recommendations as to how many and what kinds of fish might be added to the lake and how much fishing can be permitted (season, gear, and catch limits).

The biologist may later examine fish catches and, flying over lakes in a small airplane, count the people fishing.

The biologist assists in preparing environmental impact statements, predicting what effect a power dam, highway, or irrigation project will have on fish populations and suggesting ways to prevent fish loss.

When there is a fishkill, the biologist investigates the cause, such as silt, pesticides, sewage, oil spills, industrial waste, or disease. Hundreds of thousands, even millions of fish sometimes die at one time. When those responsible can be identified, the biologist may testify in court to help collect payment for damages.

The fish biologist plans and directs hatchery operations and trains workers in fish culture, decides what equipment and procedures to use; how many and what kind of fish to raise; arranges for the distribution of fish to lakes and

streams, and coordinates the program with that of other Federal and State hatcheries.

Some fish biologists are assigned to research projects. They may study the life span and migration of fish, determine what pollutants are harmful and in what amounts, or develop new diets, vaccines, and methods of crossbreeding.

Biologists write reports and give speeches, sometimes on radio or television. They are expected to deal effectively with people and to be able to supervise.

They travel, often by boat, walk over rough terrain, and do rigorous outdoor work. More than half of their time, however, may be spent in an office or laboratory. Time spent in the field varies with the assignment.

Fish biologists specialize, either in island (freshwater) fish or in marine (saltwater) fish. They protect marine life other than fish, including oyster beds, shrimp, lobsters, and crabs.

Job Requirements

The minimum requirement is graduation from a 4-year college with a major in biology (preferably the biology of fish), zoology, or fisheries management. In the junior year, the student must decide to specialize, either in freshwater or saltwater fish. A driver's license, some knowledge of chemical water analysis, computer science, and statistical methods are necessary. Advanced degrees are needed for research and for an increasing number of other assignments. The fish biologist may specialize in genetics, embryology, histology, physiology, serology, bacteriology, virology, biometrics, biochemistry, or nutrition.

There is approximately 1 year of on-the-job training, during which time the biologist becomes familiar with hatchery procedures and learns conservation laws and regulations, agency policies, and methods of administration.

Opportunities

Fish biologists work for State departments of conservation or Federal agencies, particularly the Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, and the Forest Service. A few work for aquariums, museums, biological consulting firms, the tropical fish industry, private hatcheries, fishing clubs, and fish or bait farms. Some teach in high schools or colleges or specialize in wildlife journalism or in underwater photography.

Openings are limited and competitive. The number of students studying fish biology is greater than the projected number of openings. Information on current openings can be obtained from State civil service offices and from Federal Job Information Centers. State hatcheries usually have tours and exhibits open to the public; a visit to the nearest hatchery is recommended to see firsthand what the work is.

Fish farming (the raising of fish for food) is a growing industry and more openings in this field in the future may occur.

DOT code: Aquatic Biologist 041.061-022

Fish Culturist

Assistant manager, fish hatchery
Fish technician
Hatchery supervisor

The fish culturist supervises the day-to-day operations of a fish hatchery, following procedures determined by a fish biologist.

Electronic instruments record temperature, flow, and other conditions of the water: high voltage equipment, aerators the size of buildings, indoor tanks, and outdoor ponds. The fish culturist watches to see that all equipment is functioning, since a system's failure can result in death of the fish. Usually the fish culturist must live in a trailer or cabin next to the hatchery and be on call at night in case of an emergency. Emergencies are most apt to occur in bad weather, and it is often necessary to go outdoors and check equipment in snow, wind, or thunderstorms.

The fish culturist supervises work crews that construct ponds, maintain equipment, and perform the tasks necessary for sanitation. A large part of the fish culturist's time is spent on sanitation, which means cleaning tanks and equipment that come in contact with fish.

Care of the fish varies with the time of year and runs through a cycle. In the spawning season, eggs and sperm are pressed from mature fish and mixed to fertilize the eggs. This method of artificial fertilization is used to avoid losing any of the eggs. Crossbreeding is accomplished by mixing eggs of one kind of fish with sperm from another. Pressing eggs from fish is called "stripping." It is a task that needs to be done only once a year but requires skill to avoid injuring the fish or breaking the eggs. The fish culturist trains fish hatchery workers in stripping and supervises care of the developing eggs.

Eggs are incubated in trays set one above the other in running water. The temperature of the water is critical and varies with the species of fish. Any eggs that turn white are dead and have to be removed to avoid a fungus that may spread to live eggs.

Growing fish are fed larger and larger granules of food. The fish culturist sorts the fish according to size, using an automatic sorter with bars that hold back large fish, allowing the smaller fish to swim through. As they grow, fish are moved to larger tanks indoors and, finally, to concrete raceway ponds outdoors.

The last step is transporting the fish to lakes, streams, and reservoirs. This is done by tank truck or boat. Remote lakes that cannot be reached by truck are stocked by dropping fish from a small airplane or helicopter.

In addition to supervising hatchery operations, the fish culturist may assist the fish biologist in a research project; for example, a study of how heated water from a nuclear power plant affects the development of fish in a lake. The fish culturist may work in the field, collecting and identifying fish, or may maintain a large number of fish for research purposes.

The fish culturist conducts tours of the hatchery and answers questions on the care of fish.

Job Requirements

At least 1 year of practical experience in fish hatchery or fishery work is necessary. Educational requirements vary. Some fish culturists are high school graduates who have learned on the job. However, the trend is to require 2 years of college-level education in fisheries management, biology, or zoology. A bachelor's degree is now a requirement for some openings. Regardless of the amount of education, a year of practical experience is also needed in order to become familiar with all stages in the work cycle.

To obtain a job as a hatchery worker, experience with high-voltage equipment, plumbing, machinery repair, or the use of farm equipment and the care of crops and farm animals is helpful.

A driver's license is required. It may be necessary to know how to operate and maintain a small boat.

The fish culturist receives training in hatchery management on the job for about a year and may be sent to a Federal training center for part of this time.

Opportunities

Fish culturists work in State and Federal hatcheries. A few may work for private hatcheries, research organizations, and aquariums.

Because openings are scattered, opportunities are best for fish culturists willing to relocate.

Related work may be found with fish farms that raise fish for food or with aquarium stock companies that raise goldfish or tropical fish for sale to pet stores.

Promotion to a more responsible management level is possible with additional experience or education.

DOT code: Manager, Fish Hatchery 180.167-030

Forester

Forest manager

About a third of our country is covered with forest. Forest includes wildlife, water, grass, soil, and rocks, as well as trees. Foresters manage forest land for a variety of uses: watershed, range for cattle and grazing wild animals, recreation, and cutting of trees for lumber and wood products. It is their responsibility to protect forest land against fire, flood, insect damage, disease, erosion, and excessive use.

Foresters are experts in the complex relationships between people, water, soil, animals, and plants and in the changes that can be expected in forests as one kind of tree dies and is replaced by others.

A forester plans and directs land surveys and the construction of roads, ski runs, hiking trails, swimming beaches, and campsites, as well as projects for flood control, soil conservation, and watershed improvement.

A forester recommends the purchase of forest land, draws maps, interprets aerial photo maps, writes reports, and speaks to public groups on forest conservation.

If forest land is used for grazing, the forester calculates how many wild and domestic animals it can support. The forester may seed the forest with grass or bushes suitable for forage and may reach agreements with sheep owners, for example, on seasonal use of the land.

On forest land kept as a wildlife refuge, the forester may plant berry bushes and other plants to attract the birds and animals.

When a forest is used for lumber, the forester measures the sizes and kinds of trees, figures out how much lumber of different kinds can be produced, and decides which trees to cut. The forester may also plan and direct the growing of trees from seed to replant the forest.

Some foresters specialize in one aspect of forest management, such as fire control. Some are research foresters and may work on developing faster growing trees through plant genetics and fertilization; finding how much ground cover is needed to stop erosion from snowpack runoff; controlling insects by use of their natural enemies; or improving logging practices to waste less wood.

Foresters need an unusual combination of skills and interests. They deal with government and industrial officials, enforce forest laws, supervise and train workers, and resolve disputes between forest users. They need business skills and sales ability to sell timber or lease land for resorts. They need to be resourceful in emergencies and able to organize crews to fight fires or search parties to find lost hikers. They travel and are often required to relocate. Although city forestry (managing the mass planting of trees along city streets, parks, and reservoirs) is a growing field, most foresters work away from large cities. Job opportunities exist in foreign countries, where a knowledge of other languages is helpful.

Job Requirements

Foresters need at least a 4-year college course leading to a bachelor of science degree in forestry. Practical outdoor experience is required. Most forestry schools run field camps to provide this experience. Schools may also conduct field trips giving students an opportunity to observe variations in forestry practices in different climates.

Students may obtain additional experience in summer employment with a branch of government, a forest industry, or a citizens' conservation organization. Application should be made 6 to 9 months in advance. In addition, the Forest Service uses students as summer volunteers, and arrangement may be made with a college to earn credits for this activity. An application form for volunteer work can be obtained by writing to the U.S. Forest Service, Department of Agriculture, Human Resource Programs, P.O. Box 2417, Washington, D.C. 20013, or to one of the Regional Foresters whose addresses are listed in this *Guidebook* under "Forest Technician."

A driver's license is required. The forester needs ability in speaking and writing to promote interest in forestry programs. Mathematics is used in measuring the amount of wood a forest can produce and the price it will bring. Biometrics and computer science are needed for biological surveys and research. Foresters usually do simpler work during their first year while they receive further job training.

Teaching, research, and an increasing number of other assignments require advanced degrees. Ten years ago, research was done by foresters. Today it is done by specialists in one of the sciences or in engineering. After graduation, foresters may major in economics, biometrics, public relations, entomology genetics, tree culture, botany, soil science, wildlife conservation, recreation, wood technology, or other specialty.

Opportunities

Some foresters are teachers in university forestry schools, in extension services, or in youth programs, such as Girl Scouts, Boy Scouts, 4-H Clubs, Job Corps Conservation Centers, and the Young Adult Conservation Corps.

Foresters work for private industries: sawmills, lumber companies, and manufacturers of paper and particleboard. They also work for government agencies (including the U.S. Forest Service, the Bureau of Land Management, the National Park Service, the Bureau of Indian Affairs, the Tennessee Valley Authority, and State conservation departments), forest consulting firms, citizens' organizations, and universities. Some are consultants to private forest owners. A few are hired by water companies, railroads, and mining companies to keep the forest cover in good condition or replace it after strip mining. They may also treat timbers with chemical preservatives for use as mine supports or railroad ties. Pay is generally higher in industry than in government.

Opportunities vary across the country, being better in the South than in the Northeast, but there are more people who want be foresters than there are openings for foresters.

A study of 1977 forestry graduates was made for the Society of American Foresters.[1] Of graduates with bachelor's degrees, a little more than half (54.3 percent) found forestry-related jobs, most with industries producing lumber, paper, and other wood products. A smaller number were employed by the Federal Government, mainly the Forest Service. More than half of the graduates going into Federal employment accepted either temporary jobs or work, not as foresters, but as forestry technicians. Some

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[1] Edward F. Robie, "Employment of 1977 Forestry Graduates," *Journal of Forestry*, June 1978, pp. 355-359.

graduates went to work for State governments (a smaller number than for the Federal Government) and a few for local governments. Some industrial employers refused to see graduates who did not have at least a "B" average.

What happened to the forestry graduates who did not find forestry jobs? Some, according to reports by forestry schools, used their skills in other work, such as the management of a private tree nursery, the sale of logging equipment, construction, drafting, surveying, or military service. Some went on to graduate school.

According to the Society of American Foresters study, opportunities were best for graduates with advanced degrees. Of 1977 forestry graduates with master's degrees, 67 percent found work in forestry. For Ph.D.'s, forestry placement was 83 percent, mostly in teaching and research.

A forester may be promoted after several years of experience to district forester or regional forester, managing a district or region, perhaps several hundred square miles, with responsibility for the use and protection of the forest resources. Such managers in the Forest Service are called forest rangers. The term "ranger" is applied also to uniformed workers with less experience and responsibility.

DOT code: Forester 040.051-034

Forest Technician

Forestry technician

Forest technicians assist foresters in tree planting, fire prevention and control, road construction, vehicle and tool maintenance, law enforcement, crew supervision, safety instruction, timber sales, and research activities.

A forest technician working for industry may be known as a scaler, cruiser, or surveyor. A scaler measures cut timber and calculates its volume. A cruiser takes an inventory of growing trees (height, width, kind, number of dead trees), and may mark trees for cutting. A surveyor marks out where log-hauling roads are to be built.

The government forest technician responsible for enforcing laws may be called a forest ranger (a term also applied to high-level foresters in the Forest Service), wears a uniform, and may carry a gun. The forest technician warns campers of fire hazards and investigates fires for possible prosecution of people found responsible.

Forest technicians check trees for insect and disease damage, prune and cut, destroy diseased trees, collect pollen and hand-pollinate for special projects, select superior trees and gather seed from them, and graft root stock with buds from superior trees, following directions from a forester or plant scientist.

Forest technicians interpret maps, collect data, and write reports. They install and maintain rain gauges, streamflow recorders, and soil-moisture measuring instruments. They must be able to use the metric system and record field data neatly, clearly, and accurately.

They maintain, repair, and sharpen hand and power tools, such as saws, axes, and mowers. They inspect and make minor repairs on tractors, trucks, boats, and firefighting equipment and may do minor carpentry, masonry, and painting of buildings. They may have to buy supplies.

They supervise the work crews that dig ditches, build roads and trails, clear brush for firebreaks, plant trees, sort seedlings, and fight forest fires. They may use radio-telephone equipment to report fires.

They assist in educational programs by giving talks, showing movies and slides, and distributing posters. About 80 percent of their work is in the field and 20 percent in an office.

Much of forestry work is seasonal. Trees are planted in spring and fall. Firefighting is concentrated in the fire season, which varies with the climate. Federal firefighting crews travel from Alaska to different parts of California, wherever they are needed. In California, the fire season is in the summer when it seldom rains, but the season may extend into winter because of Santa Anna winds (dry storms off the desert). In the East, spring and fall are the fire seasons. Fewer workers are needed in the winter; therefore, many laborer jobs and some technician jobs are seasonal.

Forest technicians are often required to live on the land they patrol, to be on call for rescue work in case of an emergency. They often travel over a large area and live in rugged environmental conditions. Travel may be on foot, horseback, or by boat, helicopter, or small airplane. Planes are replacing lookout towers for fire-watch duty; they are used in fighting fires and in making photographic maps for identifying kinds of trees and areas of disease.

Forest technicians must be able to work with people. They need good vision and clear speaking voices; they must be in good physical condition to walk over rough ground in all kinds of weather, to carry equipment such as supplies in a backpack, and to climb ladders. The work is strenuous, often cold and wet, and may be dangerous (particularly when firefighting). There are different assignments and many technicians specialize in one area of forest work.

Job Requirements

After completing high school, forest technicians spend at least 2 years learning forestry, either in school or in related job experience. Specialized requirements vary with the opening, but experience in using tools, instruments for measuring, and farm equipment is helpful.

An academic high school course should include mathematics and science. A vocational high school course should be in some skill useful in forestry (such as auto mechanics or drafting).

Experience related to natural resources is preferred and may be in farming, ranching, logging, surveying, landscaping, drafting, construction, or park maintenance.

A driver's license is required.

The educational requirement may be met by either a 2-year college forestry course or training as a forest ranger. Even with specialized education, practical experience may be needed. Students 18 years or older may obtain experience by taking summer jobs with parks, State conservation departments, forest industries, conservation organizations, or the Forest Service.

Information on the possibility of summer Forest Service employment can be obtained by writing the nearest Regional Forester of the U.S. Forest Service.

There are also some summer jobs with regional offices of the U.S. Bureau of Land Management. Because of the competition for these jobs, application is best made well in advance. An application form may be obtained from the nearest Federal Job Information Center or any Federal personnel office.

Opportunities

Forest technicians work in States having forest industries. There is competition for jobs, much more so in some areas than others. Some of the openings are temporary or seasonal. The percentage of forest technicians who are placed in forestry-related work after graduation from a 2-year forestry course varies greatly across the country. For example, while one school reports 100 percent placement of its graduates, another, less than 50 percent in permanent work. In areas where there is a shortage of openings for foresters, technicians must compete with foresters for technician openings. A willingness to travel may help, but local workers familiar with the area are usually preferred. It is wise for a student to check on the local demand for forest technicians before beginning training.

The demand for forest technicians may increase with better economic conditions and growing interest in outdoor recreation and conservation.

With experience, the technician may be promoted to a higher level of responsibility. Promotion to forester requires additional education.

DOT code: Forester Aide 452.364-010

Land Planner

Land-use specialist

Land planners find ways to solve human needs, such as those for open space, housing, clean air, and safe water, by planning ahead of time. It is less expensive to reserve open space for parks than to create parkland by razing buildings later. It is less expensive to locate an airport away from residential areas than to solve a noise problem after houses are built next to it.

The land planner may plan a small city park, a whole county, a transportation system, an urban renewal project, or a large recreational area.

First, the land planner meets with people who will be using the land and finds out what their needs and preferences are. Then the land planner studies the land, its soil, water, wildlife (if any), and other features and checks to see what laws or regulations might limit use of the land and what plans have been made for surrounding areas. A large amount of data is gathered on resources, needs, and conditions (such as traffic flow and population). Computer and statistical methods are used to analyze the data. Finally the land planner proposes a system for locating various activities on the land and writes a report explaining the costs and benefits of the proposal and its advantages over alternate plans.

The land planner also recommends laws and regulations, such as building codes.

When a building project, airport, or power plant is being considered, the land planner may be asked to analyze what its total effect will be on conservation, pollution, jobs, race relations, and other human concerns. The planner prepares an environmental impact statement predicting the effect of the construction on different aspects of life. For example, a highway might destroy housing and wildlife but improve business. Which is more important? The land planner is often in the middle of controversy.

Land planners need ability to deal with individuals and community groups and to present ideas convincingly in person, in writing, and in public speeches. Although they make field visits, most of their time is spent in an office.

Job Requirements

Since land planning is relatively new, workers have come to planning from other fields with different combinations of education and experience, but the usual requirement is a master's degree in planning with undergraduate work in related subjects, such as civil engineering, landscape architecture, public administration, natural science, public health, or social science (economics, law, geography, or political science).

To obtain practical experience and find out what planning is like, part-time or summer employment or volunteer work in a planning office is recommended. Also it is possible to see planners in action by visiting regular meetings of a local planning commission or attending public hearings on such issues as incinerator location.

Opportunities

Land planners work for Federal, State, county, and regional agencies dealing with land management, conservation, health, transportation, building, zoning, parks, and planning.

Land planning is a growing field, and the prospect is that more planners will be needed.

DOT code: Urban Planner	199.167-014

Landscape Architect

Community planner
Environmental planner
Land planner
Site planner

Landscape architects have always been concerned with the environment and solving problems, many of which are pollution related: What plants and trees will prevent erosion and, at the same time, enhance the appearance of a highway? What vegetation absorbs noise? What plants can coexist with animals in a zoo? How does one screen an asphalt parking lot esthetically? In many cases, good landscaping packaging can help sell projects opposed by the community.

Landscape architects plan and design developments of land areas for projects such as parks and recreational facilities, airports, highways, and parkways. They also work on projects involving hospitals, schools, land subdivisions, and commercial, industrial, and residential sites.

Landscape architects work with architects, planners, and engineers. To an increasing extent they also work with behavioral scientists and natural scientists.

Landscape architects are involved in the design development phase of projects. First, they carefully study the site. They compile and analyze data on site conditions, geographic features, and location of structures in order to prepare the environmental impact report and develop landscaping plans. In studying the site, the landscape architect notes its features, such as hills, soil, climate, plants, and even animals.

They prepare site plans, working drawings, specifications, and cost estimates for land development. These drawings show ground contours, vegetation, location of structures, and such facilities as roads, walks, parking areas, fences, walls, and utilities. They coordinate the arrangement of existing and proposed land features and structures. They also build three-dimensional models to show how their proposals will look.

Usually the landscape architect stays with the project until its completion, directing construction and often spending a large part of time outdoors. Visits to the site may continue after completion, to be sure that the client can maintain the project.

Good communication skills are very important in this work. Landscape architects spend much of their time giving presentations to clients and they must speak effectively to explain proposals. They also write detailed, concise, technical reports. They need good graphic skills to prepare two-dimensional and three-dimensional freehand and mechanical drawings and models.

This is light physical work. It also requires good eyesight, eye-hand coordination, form and clerical perception, and finger-manual dexterity to prepare drawings and models.

More than one landscape architect has begun by working in greenhouses, mowing lawns, clipping hedges, and pruning trees—valuable experience. Or experience can sometimes be gained by tracing lines and trees at a drafting board.

Job Requirements

The minimum educational requirement is a (4- or 5-year) bachelor's degree. There are also 1-, 2-, and 3-year master's degree programs available. A very few landscape architects have doctorates.

In most curricula, principles of design and ecology receive the most emphasis. The basic curriculum varies; however, courses in social and behavioral science, physical sciences, natural systems, regional and environmental planning, basic design principles, managerial skills, and basic communications are important.

In 38 States, a landscape architect is required to pass a licensing exam to practice independently.

Opportunities

Slightly fewer than half the landscape architects are employed by the government. Much of their work is related to the development of forest and park management. Others work for corporations, architectural and engineering firms, and some are self-employed.

Some landscape architects report that the attitude persists in a large portion of construction work that there is no need for landscape architects, and therefore a major change in attitude must take place. Among land developers, prospects are relatively good for increased use of landscape architects.

DOT code: Landscape Architect 001.061-018

Park Ranger

Park technician
Park warden
Ranger

Park rangers patrol, maintain, and explain park facilities to protect public parks and their visitors.

Patrol may be by vehicle or on foot. The park ranger watches for illegal hunting, cutting of trees, vandalism, and excessive noise; he enforces camp regulations; he issues citations for minor infractions, such as littering or overparking. Extensive damage, serious misbehavior, or the presence of dangerous animals are reported to the supervisor. The park ranger observes trees and reports any evidence of insect infestation or disease. Hazards, such as avalanche conditions, flooding, washed-out roads, weakened guardrails, or undercut trails, are reported immediately to the supervisor.

The park ranger makes minor repairs to facilities, following a checklist; keeps a record of activities, equipment, and supplies; directs traffic; collects park fees; issues permits; takes visitor counts; and completes standard reports.

Duties include participation in the educational program, giving prepared speeches on natural and historic features of the area, guiding visitors on nature hikes, and answering routine questions on points of interest in the park and surrounding areas. In general, the park ranger presents information prepared by others. However, the ranger may also help in preparing speeches, brochures, and displays and may assist on research projects.

The park ranger teaches safety, showing visitors, for example, how to handle a canoe. The ranger responds to emergencies, using a spray tank to put out small fires, calling for assistance on large fires, and giving first aid for broken bones, snake bite, and other accidents.

The ranger needs ability to do strenuous work in rugged outdoor surroundings, to enforce regulations tactfully, and to communicate effectively.

Work is in parks operated by Federal, State, and local government agencies. The ranger may be required to live in the park and be on call for emergencies. Parks may be in a variety of scenic, recreational, and historic spots and include, for example, Revolutionary War battlefields, Indian mounds, and the Statue of Liberty Island.

Job Requirements

Minimum requirements are a high school diploma, a driver's license, and 1 year of experience in park operations or a related field, such as recreation, archeological or historical preservation, resource management, tourism, public information, or communications. Knowledge of common plants and animals and experience in using tools are helpful.

College education in natural sciences, history, archaeology, police science, or park and recreation management may be substituted for experience.

Requirements vary for different assignments; for example, in addition to the other requirements, a park ranger in an urban area may need a knowledge of community action programs in order to promote park programs and encourage community participation.

For 6 months or more, rangers are trained on the job in agency policies, law enforcement methods, park maintenance, safety, first aid, and rescue techniques.

Opportunities

Openings for park rangers are limited and competitive. It is anticipated that there may be an increasing number of openings because of a growing interest in outdoor recreation and conservation.

Promotion is possible to supervisory park ranger (park superintendent) but may require additional education.

Information on Federal openings can be obtained by writing the National Park Service, U.S. Department of the Interior, 18th and C Streets, N.W., Washington, D.C. 20240.

DOT code: Park Ranger 169.167-042

Wildlife Biologist

Conservation biologist

The wildlife biologist defends our natural heritage of birds and other wildlife by studying their habits and the conditions they need for survival and by educating people on how to save wildlife.

Wildlife biologists count animals and study their distribution and migration, often observing them from an airplane or tracking them by radio. They study interrelationships between different kinds of animals and attempt to find a balance so that there are not more animals than food. They study the effect of pollutants, such as mercury and pesticides, on wildlife; plan sanctuaries to safeguard threatened animals; and artificially raise rare animals, such as whooping cranes, to prevent their extinction. They use statistical methods in analyzing animal populations and complex mathematical formulas for computer analysis of possible methods for reclaiming polluted land. They often act as consultants to foresters who manage the land.

Machines change animal environments. An increase in water temperature or the rerouting of a stream, the clearing of a forest, the draining of a swamp, the overgrazing of land, or the building of a city are events that have immediate effects on wildlife. Wildlife biologists prepare environmental impact statements, predicting what effect large development programs will have on the environment. Environmental impact statements have resulted in the redesign of plans for some projects.

Wildlife biologists also prepare educational materials, such as checklists of the birds and animals a visitor may find in a particular park, displays for nature centers, television news stories, and wildlife films. They may specialize in writing or in photography.

Job Requirements

Because much travel is necessary in areas where there is no public transportation, a driver's license is needed.

The student interested in wildlife biology is wise to plan on postgraduate study. Although a bachelor's degree in wildlife biology or management is the minimum requirement, most openings are in research or education and require at least a master's degree. Undergraduate work may be in biology, zoology, forestry, or agriculture.

Opportunities

Wildlife biologists work for Federal agencies, such as the Bureau of Sport Fisheries and Wildlife, the Fish and Wildlife Service, and the Forest Service; State conservation departments, biological consulting firms, conservation organizations, private wildlife sanctuaries and game preserves, outdoor magazines, and zoological gardens. They teach in colleges and universities and in public education programs.

Openings are few. This is a competitive field with more qualified graduates than jobs. Some biologists go into related occupations, such as biological laboratory work or managing a farm that raises pheasants for food.

DOT code: Biologist 041.061-030

Pesticides and Toxic Substances

There are now 2½ million known chemical compounds, and over 30,000 chemical substances in commerce, although relatively few of these substances are highly toxic as they are currently used. The problems now being dealt with have to do with the over 1,000 new chemical substances introduced each year, as well as the discovery of new problems involving chemicals already in use. The massive contamination of Hopewell, Virginia, and surrounding areas by the pesticide Kepone is an example of the hazards possible from insufficiently controlled chemicals.

The National Occupational Hazard Survey (1972-74) points out a number of grim facts having to do with the number of workers exposed to toxic substances. The survey estimates that 7 to 15 million workers are exposed to toxic substances falling under OSHA jurisdiction in products sold under trade names whose ingredients are often trade secrets and unknown to employees and employers; that up to 880,000 workers, or 1 percent of the work force, may be exposed to an OSHA-regulated carcinogen; and that one in every four workers may be exposed to OSHA-regulated substances that can cause disease or death.

There are four Federal agencies dealing with control of toxic substances—the Environmental Protection Agency, the Food and Drug Administration, the Occupational Health and Safety Administration, and the Consumer Product Safety Commission. These four agencies are now attempting to work together by sharing information and resources and by developing compatible testing procedures, research and development policies, and compliance procedures.

Protecting people and the environment from the potential hazards of pesticides is the responsibility of the U.S. Environmental Protection Agency (EPA). A major part of this responsibility involves registration of all pesticide products marketed in the United States. With their application for registration, manufacturers are required to submit data that show that the product, when used as directed, will be effective against the pest listed on the label and will not cause adverse effects to people, animals, crops, or the environment.

Legislation

In 1947 the Federal Insecticide, Fungicide, and Rodenticide Act was passed to regulate the manufacture, sale, and use of pesticides. It was amended in 1972 by the Federal Environmental Pesticide Control Act and revised in 1978. The Act extends Federal controls to the actual application of pesticides by the user and provides for the regulation of intrastate as well as interstate marketing of pesticide products. In addition, the Pesticide Amendment to the Federal Food, Drug, and Cosmetic Act provides protection to consumers against harmful residues in food.

There is a definite trend toward more stringent educational background to meet State licensing and Environmental Protection Agency requirements. Industry associations can also be expected to be influential in assuring that anyone responsible for applying chemicals to crops or structures is qualified.

In 1976 the Toxic Substances Control Act further extended controls. It provides for direct control of new and existing chemicals, requires premarket screening of new chemicals, and provides for authority to require the testing of a chemical to determine the extent of the toxicity.

The transportation in commerce of hazardous materials by all modes of transportation is regulated by the Hazardous Materials Transportation Act of 1974.

Employment

State and local governments, over the next few years, will be assuming increasing responsibility for monitoring and enforcing regulations on pesticides and hazardous and toxic substances although many more job opportunities will be found with local governments than with State governments. Public sector employment growth for pesticides and toxic substances programs is projected at 7 percent per year, conservatively, through 1981. A leveling of demand from 1980 to 1985 is based on the assumption that no further Federal legislation will add new programs.

Occupations

Some physicians work in the area of pesticide and hazardous waste problems. The pesticide use medical coordinator is concerned with the health and safety aspects of pesticides and other hazardous wastes. Environmental epidemiologists direct and conduct research on the distribution of disease in industrial environments as it affects groups of people.

Other disciplines represented include chemists, biologists, toxicologists, entomologists, and physiologists who conduct research and investigations concerning these problems as related to their specific areas of expertise. Other professionals include registration specialists who register and keep track of the use and sale of pesticides and other chemicals, and inspectors such as agricultural chemical inspectors. Hazardous waste management specialists are concerned with the treatment and disposal of hazardous wastes.

Technician level occupations include chemical applicators, pest control specialists, and inspectors. In some cases, professionals have assistants, such as the entomology field assistant or the vector control assistant. Pest control work also requires helpers to perform the lower level tasks in termite control, fumigation, and other general pest control work.

Agricultural Chemicals Inspector

The U. S. Environmental Protection Agency and the States work cooperatively in pesticides inspection activities, including investigation of misuse and surveillance of the retail pesticide market. Agricultural chemicals inspectors, for example, do inspection and sampling work for the enforcement of laws relating to spray residues, pesticides, and livestock remedies. They inspect and sample fresh and dried fruit and vegetables to determine the amount of spray residue present, and make simple titration tests and spray residue analyses. Also, they inspect and sample fertilizers, pesticides, and other materials to insure that labeling and branding is legal, and that materials conform in strength and quality to labels and claims made.

Another aspect of the field work is interviewing farmers and merchants to determine causes of violations and to advise on methods of avoiding future violations. Inspectors insure that dealers are licensed, investigate alleged violations of the law, collect delinquent tonnage reports and license fees, and prepare reports of inspections and investigations.

In addition to the necessary interest and aptitude for science studies, persons interested in this type of work need the personal qualifications to deal tactfully with people in inspection and enforcement situations that may arise.

Job Requirements

The educational requirement, for persons without related work experience, is graduation from college with a minimum of 6 semester hours in chemistry.

Two years of work experience in the manufacture or sampling of fertilizing materials, injurious materials, pesticides or livestock remedies may sometimes be substituted for college education. Requirements do vary for this work as to amount and type of college preparation, and amount and type of work experience, although the most common requirements are as listed here.

The job requires knowledge of the basic principles of chemistry, and of materials used in fertilizers, pesticides, and livestock remedies.

Also required is the ability to interpret and apply laws relating to spray residue and the manufacture and sale of fertilizers and pesticides, to determine the necessity of taking samples for laboratory analysis, to analyze situations, and to work independently without supervision.

Opportunities

This job is found in local and State governments. Most openings over the next few years will result from normal turnover, rather than expansion of programs. Agencies requiring a degree report that incumbents hold degrees in any number of fields, including entomology, chemistry, and zoology. Many employers encourage entry into this work from technician, crafts, or operator backgrounds in the pesticides field.

See "Pesticide Control Inspector" for job duties relating specifically to pesticides used by agriculture, industry, and private individuals.

DOT code: Investigator 168.276-062

Agricultural Chemist

The need for environmental chemists came about as a result of environmental damage caused by pollutants. Most chemists working in the environmental field have degrees in one of the traditional branches of chemistry (organic, inorganic, analytical, physical), and are considered environmental chemists because they work with data on the movement and fate of pollutants in the environment.

Just as there are chemists working in water pollution and other environmental programs, there are chemists in the pesticides field. Agricultural chemists make chemical analyses to determine the identity and concentration of substances that may be adulterants, contaminants, or potentially hazardous chemicals in agricultural products and chemicals. Typical work includes consulting on and assisting in the collection of field samples; assisting in the development and testing of new laboratory and field apparatus and procedures; and checking solutions and apparatus used in testing work by inspectors in the field.

It is necessary to work closely with government agency personnel at Federal, State, and local levels, particularly in the enforcement of laws relating to the inspection and manufacturing of agricultural products and chemicals. Agricultural chemists may also prepare material for court cases and at times act as expert witnesses in court cases.

Depending on the laboratory size and staffing, the agricultural chemist may be in charge of a section and direct work in the quantitative and qualitative analyses of pesticides, fertilizing materials, spray residues, commercial feeds and remedies, and meat or dairy products.

Agricultural chemists may also specialize in the registering of agricultural chemicals, determining that adequate methods of chemical and residue analyses are available to evaluate the public health and the environmental aspects of pesticides.

Job Requirements

The education required is graduation from college with major work in chemistry or biochemistry. As of late 1977 no university offered a defined curriculum leading to an undergraduate or graduate degree in environmental chemistry; the University of California at Davis, however, has had a Department of Environmental Toxicology since 1974.

Professional work experience of 1 or 2 years in the chemistry field may also be required. When there is a work experience requirement it usually can be waived by a graduate degree in chemistry. Many employers have also established positions at the junior chemist level, requiring no professional work experience. Entry at the junior level would initially involve working under closer supervision.

The work requires knowledge of organic, inorganic, analytical, and physical chemistry and biochemistry; quantitative and qualitative analysis and instrumental methods of analysis; mathematical modeling; soil chemistry; physics; photochemistry; and chemical laboratory work experience.

Opportunities

Opportunities are projected to be very good for all environmental chemists at all degree levels for the foreseeable future.

Source of additional information: American Chemical Society, 155 - 16th Street N.W., Washington, D.C. 20009.

DOT code: Chemist 022.061-010

Agricultural Pest Control Specialist

Pest-control advisor

Among the opportunities available to persons interested in biological field work are technician-level jobs in the pest control field, which do not require a 4-year college degree. Agricultural pest control specialists inspect crops in the field by taking samples and observing the overall appearance of the plant to detect pest infestation or evidence of harmful organisms.

Pest control specialists are often called upon to suggest preventive measures, such as selective spraying at reduced dosage, planting trap plants to lure pests from the main crop, or introducing parasites and predators to control the pest.

When the decision has been made to apply chemical pesticide, pesticides control specialists may be called upon to plan and coordinate activities of seasonal workers assigned to the project. In the capacity of crew leader, they train and supervise laborers in the use of equipment, such as sprayers, chemical applicators, and turbine blowers. These activities require a combination of personality and leadership ability to issue work orders, maintain discipline, and teach the work to others, as well as mechanical aptitude to service, maintain, and repair equipment.

As this work can be at an entry and training level, the most difficult and responsible work is not performed right away. After approximately a year on the job the pest control specialist may handle the full range of duties. These include working cooperatively with homeowners, growers, and government agency personnel, and negotiating work agreements. Also, experienced workers perform flight duties, including aerial mapping, insect release, and observation in aerial pesticide application. They evaluate field conditions that could affect the safety of work projects, and keep records and prepare reports of work completed.

Job Requirements

The minimum experience requirement for hire at the training level is 2 years of full-time experience in agricultural work, including at least 6 months of experience performing agricultural pest control work. Up to 1½ years of college may be substituted for the experience in agricultural work, on a year-for-year basis. Entry may also be possible at a higher working level if the applicant has additional pest control work experience.

This work requires knowledge of the current methods, terminology, and equipment used in surveying and controlling agricultural pests. Knowledge of pesticides regulations is also necessary.

Opportunities

State and local governments are the primary employers in this line of work. Most future openings will result from normal turnover, rather than from expansion or growth of programs. Advancement possibilities to professional level in pesticides work are excellent.

There is a trend toward licensing requirements for agricultural pest control specialists. In California, for example, where 40 percent of agricultural pesticides are applied, specialists need to be licensed by the State. By 1980 pest control specialists will be required to have a bachelor's degree in agriculture or allied science and to meet continuing educational requirements to be licensed.

DOT code: Scout 408.381-010

Agricultural Services Biologist

Biology is another of the scientific disciplines important to the pesticides field in both research and advisory capacities. Increasingly, emphasis in pest control is on using biological rather than chemical means of control. Biological control, in which natural forces and predators are used for pest control rather than chemicals, is at last gaining ground. Many researchers and scientists recognize that ultimately the biologist, and not the chemical company, will provide the basic answers to pest control.

Agricultural services biologists are concerned with assuring exclusion of pests and the protection of both agricultural and ornamental plants. They develop and evaluate programs to evaluate potential impact of pests on plants, and provide data that are the bases of training in methods and techniques of preliminary identification, specimen preparation, life cycles, hosts, and the habitats of plants and pests.

Biologists in the pesticides field may work in any number of environmental settings. Those engaged in research may work as members of technical research staffs, conducting pesticide use analysis and developmental research on biological and chemical control methods. Biologists who specialize in the study of insects are called entomologists (see under ''Entomologist'' details relating to this specialty). As long as chemical control methods are used extensively, new chemicals must continue to be developed because many

pests become resistant to chemicals in relatively short periods. Agricultural services biologists may also specialize in the plant nursery and seed field, investigating insects, plant diseases, and weed pest problems and providing advisory service to the nursery and agricultural industries. Others work at border locations, assisting in the development of inspection techniques and serving as advisors on regulations concerning exportation and importation of agricultural commodities from other countries, States, or counties.

Success in this work requires the ability to plan, organize, and direct the work of others; to establish and maintain cooperative working relationships with representatives of numerous agencies and groups; and to analyze situations accurately and make independent recommendations. Verbal ability, both spoken and written, is required.

Job Requirements

There is usually an entry and training level for this work, which requires graduation from college with a major in biological science, including at least 10 semester units in plant biology and 10 semester units in vertebrate biology. Entry at a higher level may be possible with professional work experience as a biologist in the fields of invertebrate and vertebrate pests.

The job requires knowledge of botany, zoology, and mammalogy; botanical and zoological classification and identification; pest control methods, materials, and equipment; and pest problems affecting the production of agricultural crops.

Opportunities

Most job opportunities in the near future will be the result of attrition, rather than of new or expanded programs. Because of the increasing interest in biological control of pests, some positions may involve extensive research in these methods. This is only one of many possible specializations for biological sciences majors.

Source of additional information: American Institute of Biological Sciences, 1401 Wilson Boulevard, Arlington, Va. 22209.

DOT code: Biologist 041.061-030

Entomologist

Entomology is the science that deals with insects. Because there are so many insect species, and because they are of such great economic importance to the agricultural industry, there are two main specialties within the field: systematic entomology and economic entomology.

The systematic entomologist is a laboratory and research worker concerned with the identification and classification of insects, whereas the economic entomologist works directly with control of insect pests. Large establishments may also afford the opportunity of working in various subspecialties, such as mosquito control, plant protection, pest-control management, or pesticide cost benefits.

Economic entomologists conduct control and eradication projects or aid cities and counties in detection surveys. Surveys are conducted to determine the extent and status of insect pests and their economic impact on hosts and to propose a repertoire of progressively intense control procedures. In the course of this work they secure bids from commercial pest control operators and formulate contracts for the application of insecticides or other procedures. Also, they evaluate the effectiveness of procedures used for surveying and pest control.

Systematic entomologists work primarily in laboratories where they prepare and identify native and foreign insects and compile data on the distribution and status of insects of economic significance. They collect research information relative to injurious insects and maintain properly classified reference collections of insects.

In addition to an aptitude for scientific studies, the student interested in a career in entomology should have a strong liking for research work.

Job Requirements

The entry hiring level usually requires graduation from college with major work in zoological sciences, including at least 20 units in entomology, and does not usually require work experience. Entry may also be possible at higher levels with several years of specific work experience in economic or systematic entomology, or with a master's degree in entomology.

The job requires knowledge of the classification and economics of the major plant pests and of other arthropods and mollusks of the United States; principles and techniques used in identifying, evaluating, and controlling these pests; literature on entomology; horticulture and native plants; and the relationship of plants, plant pests, and pest control to the agricultural environment.

Opportunities

Opportunities should be good for degree holders in this field, with choices of specialization. There is much competition for jobs by graduate degree holders, especially for jobs in research and teaching, where advanced degrees are virtually required for hiring.

DOT code: Entomologist 041.061-046

Entomology Field Assistant

In support of the many professionals working in the pesticides field are numerous technicians and aids, particularly in pest control field work which involves carrying out procedures in the survey and control of insect pests.

Field assistants work under the direction of entomologists in trapping insects and in fumigating and spraying. They assign work and give instructions to laborers on pest control projects and personally work with the crews. As crew leaders they also arrange for the transportation of crew workers, keep records, and prepare reports on work completed in the field.

With increased experience, field assistants take on more responsible work with less direction from the entomologist in charge. Assistants survey and record information on insect infestations, take samples of insect populations, estimate and order chemicals and equipment in control projects, and judge results of control measures taken. Typical work for more experienced assistants includes laying out work areas for crew workers and insuring that insecticides are effectively applied.

In the course of this work, field assistants come into contact with government agency agricultural officials, growers, landowners, and representatives of other government agencies working on similar projects.

Decisionmaking, and organizational and mechanical ability are required to service and maintain equipment in the field; adequate verbal ability is necessary to direct workers, confer with other control workers, including professional staff, and to prepare records and reports.

Job Requirements

Most employers require at least 2 years experience in agricultural work, part of which must have been directly associated with insect control duties. A combination of work experience and agricultural or sciences education beyond high school, such as community college or vocational school courses, is also acceptable in most cases.

The work requires knowledge of the methods, materials, and equipment (including gas engines, spray guns, turbine blowers, and fumigation and other equipment) used in the control of insect pests.

Opportunities

Job opportunities are found with local and State government agencies. Normal turnover and advancement of workers to higher level jobs account for most job openings.

DOT code: Biological Aide 049.384-010

Environmental Epidemiologist

Epidemiology, as it relates to the environmental control fields of Pesticides and Toxic Substances, is concerned with directing and conducting research on the distribution of disease in industrial environments, and in its effect on groups of people rather than on a single individual. The work is also concerned with the health effects of selected chemicals.

Epidemiology has a statistical as well as experimental aspect. Statistically, it includes devising computer codes for demographic and work history information, making statistical comparisons of causes of mortality from selected working populations against standard populations, and making final analyses for the purpose of interpreting any observed health data.

In experimental epidemiology the scientist may produce epidemics in laboratory animals for the study of certain problems, or he/she may work in the field and study epidemics in humans. Epidemiologists also compile similar kinds of data in statistical format to illustrate common patterns of disease in certain occupations, and to show instances of inconsistent results for other occupational groups. They also negotiate with representatives of industry to select occupational groups for study, maintain contact with personnel of government agencies to obtain research data, and coordinate data collection and evaluation work.

From the occupational description we can see that this work requires high numerical ability, good verbal and public relations skills, and strong interest in a career in science.

Job Requirements

Traditionally, epidemiologists have come from the ranks of M.D.'s, and the requirements have included possession of the M.D. degree, completion of internship, a graduate degree from a school of public health, and professional public health work experience. Now, however, training is available at the master's and doctoral levels. Schools of public health now report that 75 percent of persons in training are not physicians.

Opportunities

Opportunities are now very good in both private industry and government, and demand is expected to increase still more over the next 5 to 10 years. New legislation has spurred hiring in all sectors, and private industry is beginning to utilize epidemiologists extensively in research.

DOT code: Environmental Epidemiologist*

Hazardous Waste Management Specialist

Among the many chemical substances that are constantly being developed and produced are some that may be very dangerous to human health or the environment. Federal legislation (the Toxic Substances Control Act) requires that testing and necessary-use restrictions be imposed.

The work of hazardous waste management specialists has to do with the disposal aspects of such waste; they conduct research and give technical assistance on hazardous waste projects, particularly in problems of containment (isolating substances from the environment), and problems of treatment (converting hazardous substances to nonhazardous or less hazardous substances).

Most positions are with government agencies or in the research field. Those working with government agencies frequently assist in developing rules and regulations to control hazardous wastes adequately and thus protect humans and the environment from harm. They survey industries to determine the types of disposal problems and their magnitude so that programs can be tailored to needs.

Another important task is assessing available hazardous waste treatment and disposal alternatives and the costs involved, including transportation, to compare the economic impact of alternative methods. In a consultant capacity, hazardous waste specialists provide advice and technical assistance to both industry and government agency representatives.

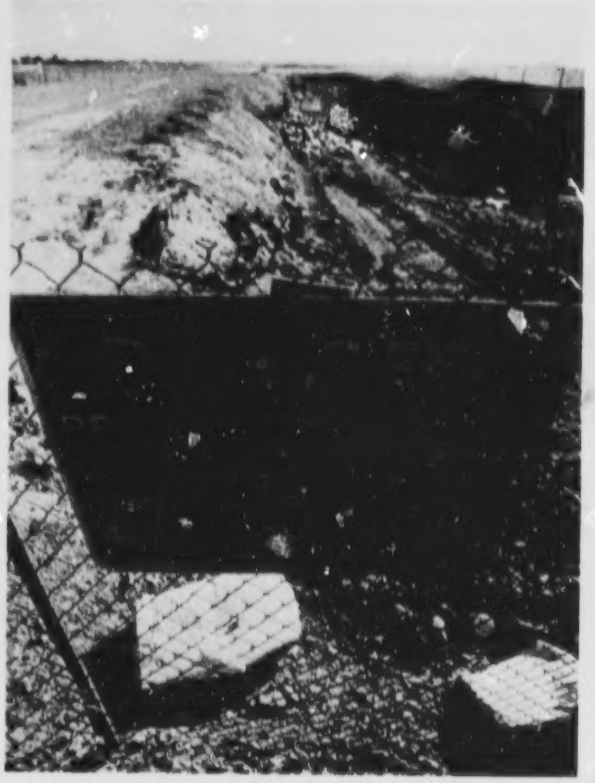
A successful career in this field calls for an interest in the sciences, specifically engineering, chemistry, and environmental health. As with many other environmental sciences jobs, high verbal and numerical aptitudes are also required.

Job Requirements

This job requires graduation from college with a major in environmental resources management, a biological science or related physical or environmental health science, and courses in chemistry. Entry at the journey level requires several years of work experience in public health or environmental management at a professional level. Entry to many agencies at the junior or assistant level is possible without professional work experience.

Knowledge requirements include those of waste management and public health engineering practices; treatment and disposal methods of hazardous waste; and the engineering design and operation of waste management facilities.

Opportunities



New legislation covering hazardous waste will promote increased employment in research, regulation, inspection, and enforcement programs at both professional and technician levels. Many industrial firms conduct extensive research into hazardous waste treatment, containment, and disposal, and employ research staffs in this effort. Positions in research typically call for advanced degrees.

DOT code: Hazardous Waste Management Specialist*

Industrial Hygiene Chemist

Expanding industrialization and increasing knowledge of dangers to workers in the workplace has made possible careers in several industrial hygiene specializations. Industrial hygiene chemistry is such a specialization. The work is something of a combination of industrial hygiene investigation and research chemistry. Essentially, the industrial hygiene chemist conducts analytical and investigative chemical and physical tests to evaluate toxic chemicals as health hazards to employees in industrial plants.

Among important job tasks are collecting field samples and conducting surveys regarding industrial hygiene, sanitation, and exposure of workers to health hazards; conducting laboratory and field analyses of abrasives, solvents, and other materials used in industrial plants; and making specialized measurements of air samples to identify and measure contaminants.

Frequently the industrial hygiene chemist is responsible for the operation of a chemical laboratory for an industrial firm or a government agency. The chemist directs and conducts research in toxicology; maintains laboratory records and prepares reports on results of studies and projects; and develops new and special methods, procedures, and equipment to be used in laboratory and field studies. The chemist is not isolated in a remote laboratory, however; the work also involves frequent contact with engineers, health agency personnel, and industrial managers to solve problems of industrial health and hazards to workers.

Although the work requires analytical ability and a strong interest in science it also requires the ability to get along well with people. Chemists in this field may find it necessary to defend unpopular findings or negotiate for needed changes in processes or equipment.

Job Requirements

The educational requirement is a bachelor's degree with a major in chemistry or biochemistry. Several years of work experience as a professional chemist are also necessary for hire at the full professional level. Possession of a master's degree in chemistry or biochemistry may usually be substituted for part of the experience requirement. An assistant level may also be gained without professional work experience in the field.

Extensive knowledge of the toxic effects of compounds and substances is required, as well as knowledge of analytical, physical, organic, and inorganic chemistry.

Opportunities

Opportunities are expected to increase for this specialty in both government and private industry. The establishment and expansion of private industry safety and health programs; the increasing responsibility of States in enforcement of occupational health and safety standards; and the more comprehensive Federal legislation now in effect, all point to significant increases.

Sources of additional information: American Industrial Hygiene Association, 66 South Miller Road, Akron, Ohio 44313; American Chemical Society, 1155 - 16th Street N.W., Washington D.C. 20009.

DOT code: Chemist 022.061-010

Pest Control Helper

Entry into the pest control field, with its large volume of jobs in both government and private industry, is usually at the helper level. There are actually three subspecializations

in this field: termite control, fumigation, and general pest control work.

Pest control helpers assist in controlling field rodents and noxious weeds, and in pest control in and around buildings and facilities. Beginning workers perform tasks such as setting traps and putting out poison bait; treating rodent burrows with lethal gases; destroying weeds and digging, burning or spraying with chemical herbicides; and observing and identifying common field rodents and weeds and reporting evidence of infestation. Helpers may be required to use firearms to eliminate field rodents.

In fumigation, several helpers usually work on the same job because buildings must be covered with tarpaulins to seal them prior to the release of fumigating toxic gases. When working with termite control representatives, the helpers assist in treating areas with pesticides, replacing damaged wood, and improving ventilation in damp areas. The maintenance and minor repair of equipment may also be involved.

Persons interested in this work should possess good manual dexterity and coordination, and be physically strong and healthy.

Job Requirements

There is usually no experience or educational requirement for these entry jobs. A driver's license may be necessary. (For additional information on work in the pest control field see the description for "Pest Exterminator.")

Opportunities

Opportunities should be good because of industrial growth, the large volume of helper jobs, and replacement needs. Many helpers are promoted to pest exterminator.

Sources of additional information: The National Pest Control Association, 250 West Jersey Street, Elizabeth, N.J. 07207.

DOT code: Pest Control Helper*

Pest Exterminator

Pest control operator
Pest control technician
Termite control representative
Fumigator

Structural pests that attack wood or infest structures include fungus, termites, borers, rodents, cockroaches, silverfish, and ants. Other pests that harm turf and ornamental plantings include insects and related organisms, noxious weeds, fungi, and animals. Pest exterminators perform independent journey-level work in control of pests in and about buildings and grounds. They inspect buildings and grounds to locate and identify infestations, prepare recommendations for treatment, and submit cost estimates for jobs. When treating for termites they work individually or with a helper to replace damaged wood, improve ventilation to eliminate damp areas, pressure-inject chemicals into timbers and topsoil, and treat areas with pesticides.

Fumigators work with crews of two to four helpers, installing tarpaulins over infested buildings to seal them. They supervise all work, notify local fire authorities that the building is unoccupied and may contain fumigating toxic gases, release premises back to the occupants, and file reports of jobs completed.

Pest exterminators work individually or with a helper when treating outside areas and grounds with pesticides and placing traps or poison baits to control pests.

Workers drive employer-owned vehicles. They work in varying conditions, such as dusty attics, tight crawlspaces, and wet grounds. The work is physically strenuous and may require crawling, stooping, climbing trees, and lifting heavy equipment. Some pesticides are highly toxic to humans and require careful and special handling. Good manual dexterity and eye-hand-foot coordination are required.

Job Requirements

There is usually no stated educational requirement. Termite control and other types of pest control may require separate licenses; licensing demands some experience working under supervision and the passing of a written examination. Some States may require as much as 6 months' experience for a license in fumigation work. Pest control companies must be headed by operators who must have 2 years' experience. A driver's license is usually required.

Knowledge of the laws and regulations governing safe and proper use of pesticides is required, as well as knowledge of rodents, noxious pests, and pests that attack people.

Equally important is the pest exterminator's knowledge of methods intended to prevent pests from getting out of hand in the first place. Trash and discarded lumber piled against the structure can be removed, air ventilation holes opened, and rodent access screens and other structural modifications may be performed to prevent pest problems.

Opportunities

Most training is on the job, with the trainee starting as a helper. Job opportunities will continue to be available in volume because of relatively low pay, possible danger in the work, and the seasonal nature of some jobs.

Sources of additional information: The National Pest Control Association, 250 West Jersey Street, Elizabeth, N.J. 07207.

DOT code: Exterminator 389.684-010

Pesticide Control Inspector

The risks or hazards of applying chemical pesticides have increased in recent years with the sharp rise in their use by agriculture, industry, the government, and householders. Over 32,000 pesticide products are registered with the Environmental Protection Agency.

Pesticide control inspectors work to insure that the sale and use of pesticides minimize danger to the health of the public and to the environment. Inspectors are usually employed by Federal, State, or local control agencies and work primarily in the field, in an assigned geographic area. A major task of the work involves inspections of wholesale and retail distributors and commercial applicators of pesticides, to determine compliance with laws and regulations on the handling, sale, and use of pesticides. Premises must be inspected to insure that only properly registered pesticides are handled, that proper permits have been secured by handlers, and that restricted pesticides are sold only to authorized users. Shelf stock is checked for proper labeling, misbranding, or adulteration, and is confiscated or quarantined if not in compliance.

When dealing with commercial applicators, inspectors verify proper registration and permits; insure that the applicators are using restricted pesticides in accordance with directions; that their equipment meets required standards; that accurate records are maintained; and that containers and unwanted pesticides are disposed of properly. Inspectors also answer questions from the public on the use of pesticides and investigate complaints.

In emergency situations involving insect infestations or outbreaks of plant disease, inspectors may identify the plant or disease, recommend treatment, and authorize emergency use of a pesticide.

Persons interested in this occupation need the personal qualifications to deal successfully with the many people encountered in the course of their work, and the ability to work independently without direct supervision.

Job Requirements

There are usually a number of options open for entry into the work. An employing agency might typically require 1 or 2 years of experience in pesticides and a bachelor's degree with specialization in the biological sciences; an associate's degree in forestry or agriculture and 2 or 3 years of pesticides experience; or 5 or 6 years of experience only. The experience can usually include pesticide sales, regulation, or use, or experience in agricultural inspection or research.

The inspector must usually be willing to travel frequently and extensively, and have a driver's license.

The job of pesticide control inspector requires a knowledge of the methods and procedures for carrying out investigations; a knowledge of the methods and materials used to control pests; and the ability to recognize the effects of pesticide pollution.

Opportunities

Most openings in these occupations will result from normal turnover. A modest yearly increase, however, in the number of workers hired is expected. If pesticides enforcement staff are also required to be responsible for enforcement of portions of the new Toxic Substances Control Act there could be additional hiring.

See "Agricultural Chemicals Inspector" for job duties relating to chemicals used in agriculture generally.

DOT code: Investigator	168.267-062

Pesticide-Use Medical Coordinator

In recent years, the risks of using pesticides have risen, along with their increased use. Fortunately, concern among the public and scientists alike has led to greater research into the dangers, both immediate—from misuse and lack of knowledge of side effects—and long-range—from residues of pesticides that can build up in the food chain and cause widespread contamination.

Pesticide-use medical coordinators evaluate the human health and safety aspects of pesticides and other agricultural chemicals to which people are exposed. They study the long-term health implications of low-dose pesticide exposure; provide recommendations on medical regulations governing the use of pesticides, and recommend safe levels of pesticide residue in agricultural products. They are also concerned with worker safety and recommend specifications for safe working conditions for workers exposed to pesticides or their residues.

Medical coordinators work closely with other professionals in this field. They consult and confer with agency representatives, physicians, researchers, and Federal officials on matters such as design of programs to improve the ability of physicians and other medical personnel to diagnose correctly, treat, and report pesticide related illnesses; occupational health and safety standards; and the nature and effects of agricultural chemicals on people.

Preparation for this work is extensive—it requires the many years of education necessary to become a doctor, plus significant work experience. Medical coordinators must also possess the ability to interpret and evaluate research findings; establish and maintain cooperative relationships with administrative and other personnel; write articles and prepare reports for publication; and make public presentations and address interested groups on controversial issues.

Job Requirements

The minimum requirement for the work is 3 years of experience as a physician with some concentration on the medical aspects of pesticides.

The job requires knowledge of the principles and practices of general and preventive medicine and skill in their application; the health and safety significance of the use of pesticides; Federal, State, and local programs for the surveillance and control of pesticide usage; pathogenic features of pesticides; methods of collecting, tabulating, and analyzing data relating to pesticides; and methodology and procedures for evaluation of findings as related to advanced research in the field of pesticides.

Opportunities

This a low-volume occupation, found at local, State and Federal government levels.

DOT code: Medical Officer	070.101-046

Plant Physiologist

Plant physiology is a specialization of general physiology, which is that division of biological science dealing with the normal functions of the living body. The two other specializations are animal physiology and medical (human) physiology.

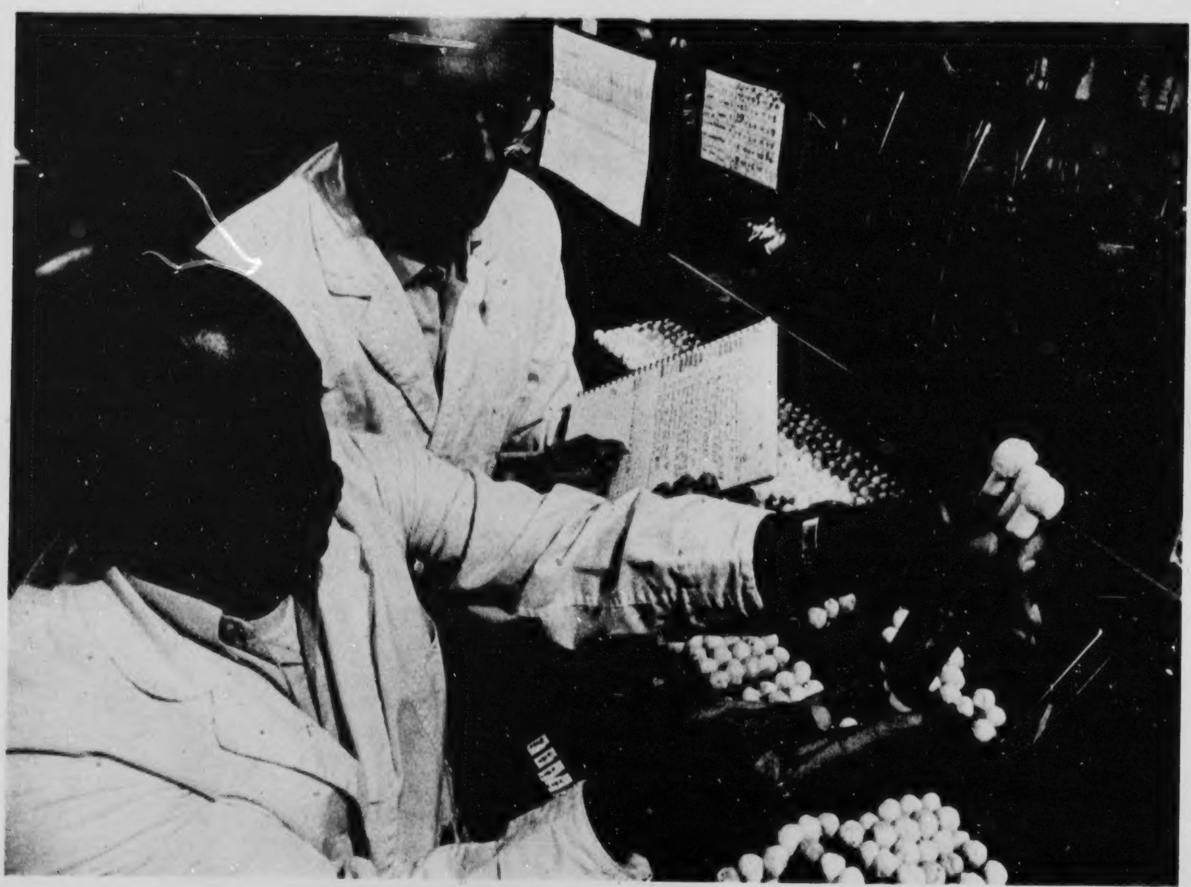
Plant physiologists' working in the environmental control field usually direct and conduct research on performance of pesticides and methods of applying them on agricultural crops and other plants. Frequently, they supervise and direct the work of other professional and technical personnel. Research work may also include reviewing and evaluating data on the effectiveness and toxicity of pesticides and agricultural chemicals. Plant physiologists who are employed by government agencies provide the scientific expertise to review labeling on pesticides to determine that recommendations are safe and effective for the use intended; this is a major responsibility because of the number of new pesticide products introduced yearly.

Although we may consider plant physiologists as primarily laboratory scientists they are often involved in activities that take them into the field. They frequently meet and confer with other professionals to exchange information and maintain scientific expertise. Others working in the plant physiology field may include college and university research workers, experimental station personnel, and Federal, State, and local government personnel. Plant physiologists working with government agencies may be called upon to testify as expert witnesses in hearings and court proceedings.

In addition to strong interest in and preparation for a career in the biological sciences field, anyone interested in this work should have high verbal ability, spoken and written, and the personality to supervise others successfully.

Job Requirements

The experience requirement is usually for at least 5 years of experience in plant physiology, 1 year of which must have involved complex technical or supervisory assignments. The minimum educational requirement is graduation from college with a major in plant physiology or a closely related biological science. Additional professional experience may sometimes be substituted for part of the educational requirement; and graduate education may usually be substituted for at least part of the experience requirement.



Entry opportunities may be available at a junior or assistant level with the bachelor's degree and without professional work experience.

Required are knowledges of the technical methods and equipment used by a plant physiologist; plant growth habits; toxicity symptoms; harvesting methods and techniques relative to desiccants and defoliants; horticultural and agricultural crops grown in the area; and provisions of the agricultural code relating to agricultural chemicals and feeds.

Opportunities

Job opportunities should be good at the State and local government levels, although the occupation is not high volume. Graduate degrees usually increase competitiveness. Additional opportunities may be found in research and teaching, where graduate degrees are increasingly important, and may be required for employability.

DOT code: Plant Physiologist	041.061-078

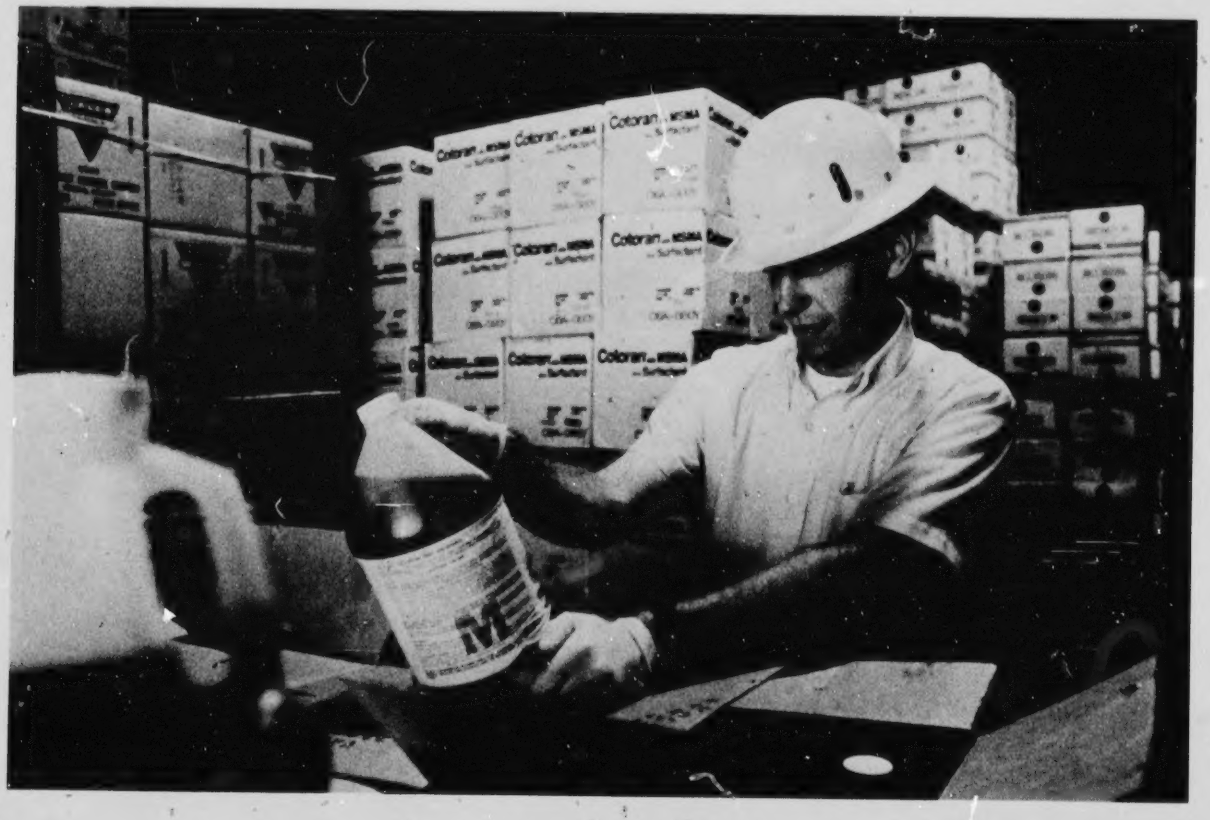
Registration Specialist (Agricultural Chemicals)

The Federal Environmental Pesticide Control Act of 1972, with all of its provisions in effect by 1976, imposed extensive new regulations on the uses and distribution of pesticides. The Act calls for cooperative efforts between the Environmental Protection Agency and State enforcement agencies, including the registration of all pesticides.

Many professionals work in this field, registering pesticides, commercial fertilizers, agricultural minerals, auxiliary soil chemicals, and other materials. Registration specialists are responsible for receiving applications for new pesticides and changes in ingredients or usage instructions; routing manufacturers' scientific data to appropriate evaluation staff, such as toxicologist, microbiologist, or plant pathologist; and assuring that the product meets or complies with Federal and State laws. Registration specialists also cooperate with county agriculture officers to investigate unusual or unanticipated reactions from pesticide use.

Other activities of registration specialists include reviewing proposed labels for products to verify adequacy of warnings and antidotes; reviewing proposed revised labels for products which are already registered; and maintaining files of technical information on the use of pesticides. At times they may be assigned to conduct special studies or investigations in such areas as evaluation of pesticide residue on crops or compliance with Federal and State laws.

Success in this work requires proven aptitude for the sciences, high verbal ability, analytical ability, and, because of the grave consequences that could result from errors, good judgment.



Job Requirements

Hiring requirements include graduation from college with at least 6 semester hours in chemistry; and 1 or 2 years of work experience in the formulation, sale, sampling or inspection of pesticides, commercial fertilizers or similar materials, or in regulation of the application of pesticides. Usually additional related work experience may be substituted for the required education on a year-for-year basis.

Successful job performance requires knowledge of applicable laws and regulations relating to pesticides, commercial fertilizers, agricultural minerals and related products; methods and procedures of official registration authorizing the sale of chemicals and the hazards involved in their use; and literature in the field of agricultural chemicals and sources of research information.
and local government agencies employ workers in this category.

Opportunities

Modest program expansion and normal turnover will account for most vacancies within the next few years. State and local government agencies employ workers in this category.

DOT code: Registration Specialist*

Toxicologist

While we have enjoyed the economic and social benefits of chemicals we haven't always realized the risks that may be associated with them. For many chemical substances we have little knowledge of the ill effects they might cause after many years of exposure. The problem is compounded by a dramatic surge in the development of chemicals in the last 35 years; at this time at least a thousand new chemical substances are introduced each year. Much work must be done in the field of toxicology to identify and evaluate the hazards that chemical substances and mixtures may pose to health and the environment.

Toxicologists may serve as research specialists, or as staff advisors, depending on the work setting. In a public health or agricultural department setting toxicologists design and carry out studies to determine the physiological effects of various substances, chemicals, and products; and advise on the toxicological properties of products and chemicals in the event of health problems. They work with experimental study data, interpreting study results in terms of toxicological properties and hazards. Toxicologists also evaluate the adequacy of toxicological data submitted for review, and provide expertise in the evaluation of label claims prior to the registration of pesticides, chemicals, agricultural chemicals, and other products. In cases of accidental exposure or poisoning they give advice as to the nature and degree of the toxic hazard involved, and also advise on precautionary labeling for the use of hazardous chemicals and products.

Many toxicologists are employed by chemicals manufacturers in research and developmental work. They conduct extensive testing programs and devise testing procedures and standards. These, industry follows in its required testing of chemicals for their effects on human health. Toxicologists must also provide much of the information and test data required by the U.S. Environmental Protection Agency prior to the manufacture of a new use of an existing chemical.

Because of the extensive and difficult academic preparation necessary for this work, anyone interested in a career in toxicology should be a very good science student, with verbal and numerical aptitudes.

Job Requirements

The job usually calls for possession of a doctoral degree in toxicology, biochemistry, pharmacology, or a closely related field. An increasing trend requires that the degree be in toxicology only. Also necessary for many positions is postdoctoral work experience, including consultation on and interpretation of toxicological findings concerning health hazards and development and design of toxicology research and investigative studies.

Increasingly, however, jobs are becoming available for holders of bachelor's and master's degrees in toxicology, and colleges and universities are now offering degree programs at those levels.

The work requires knowledge of the aspects of biochemistry that relate to the fields of toxicology and pharmacology; laboratory procedures and principles for scientific investigation of experimental relationships between chemical species and biological systems; and provisions of laws, rules, and regulations pertaining to the use, processing, and handling of toxic substances.

Opportunities

Opportunities should be good for graduate degree holders, particularly at the doctorate level, and in many work settings—Federal, State, and local governments; industrial research; and education. The new toxic substances legislation should contribute to hiring in this specialty.

DOT code: Toxicologist*

Vector Control Assistant

Among the nonprofessional and entry jobs in the pest control field are opportunities for laboratory and field assistants. Vector control assistants assist professional staff responsible for preventing and controlling vectors (disease-transmitting organisms) and hosts of diseases important to public health. The work can be very varied, and can include participation in investigation, identification, control, and prevention duties.

Vector control assistants learn the principles and techniques of biological investigation, such as collection of specimens, use and care of laboratory equipment, laboratory techniques, identification of arthropods and mammals, and preparation of reports. They assist in surveys of rodents, flies, aquatic insects, and in special problems of solid waste disposal.

As they acquire experience and knowledge, vector control assistants can perform more skilled and difficult work, that is, identifying disease vectors; using collection devices such as sweeps and traps to determine presence and density of vector populations; and preparing, mounting, and storing specimens. Public contact field work is usually part of the job. The assistant accompanies professional staff on field visits and in consultations with representatives of public health agencies on types of vectors and means of biological, environmental, and chemical control.

An interest in and liking for high school level biology lab and field work would be both good preparation and proof of aptitude for this work. Verbal ability must be adequate to prepare reports and confer with professional staff.

Job Requirements

Vector control assistants usually work for public health agencies (State or local) and may be hired with a minimum of 6 months' experience in any vector control work(such as aid, trainee, or laborer). With 1 or 2 years of related experience, the applicant may be hired at the second level, performing more independent and difficult work. The experience requirement can usually be waived for those with 2 years of college, with courses in the biological sciences.

Entry at either level requires basic knowledge of the techniques and field equipment used in vector control and of general biological sciences. Those interested in this work should also have the ability to interpret and apply rules and instructions, record data clearly, and analyze situations accurately.

Willingness to travel may be required.

Opportunities

Opportunities should continue to be good for this work; many persons are promoted from this work to inspector and other professional level jobs.

DOT code: Vector Control Assistant*

Solid Waste Management

Although solid waste management is in the midst of a transition from open and burning dumps to the sanitary landfill, the predominant means of solid waste disposal today in the United States is still open dumping, whereby a city or community has a piece of land, and collection trucks and individuals dump wastes indiscriminately. A U.S. Department of Health, Education, and Welfare survey of several years ago identified more than 13,600 solid waste disposal sites, and less than 5 percent of them were considered to meet the minimum standards for sanitary landfills. A more recent survey (1976), found that only 5,800 of an estimated 16,000 municipal land disposal sites complied with State regulations.

Health hazards are created by dumps through the presence of biological and chemical contaminants, which air, water, birds, insects, and rodents carry to people and domestic animals. In addition, dumps pollute both surface and groundwater, provide food and shelter for vermin, and disfigure the landscape.

A sanitary landfill can be designed and operated so that solid wastes can be disposed of on land under conditions that control odor, rodents, insects, and air and water pollution. In a sanitary landfill, solid waste is spread in thin layers, compacted to the smallest practical volume, and covered over in a manner that safeguards against pollution.

Many States and localities are investigating waste disposal systems that have a second purpose, the recovery of energy and other valuable resources. Increasing scarcity of landfill sites in particular and rising energy prices encourage the adoption of resource recovery technologies. Currently, about 25 communities have resource facilities in operation or under construction, and another 25 have design or feasibility studies underway.

At present a great volume of industrial solid waste is disposed of at company sites or at municipal landfills, and the majority of the waste receives no treatment prior to its disposal. Wastes extracted from water treatment and air collection systems are treated as solid wastes; as restrictions tighten, disposal of hazardous solid wastes, by volume alone, will become a major waste management problem.

Legislation

Beginning in 1965, the Solid Waste Disposal Act initiated a research and development program for new and improved methods of solid waste disposal, and provided technical and financial assistance to State and local governments in solid waste disposal programs. In addition, the Resource Conservation and Recovery Act of 1970 was passed to provide financial assistance for the construction of solid waste disposal facilities and for the improvement of research programs in solid waste management.

Other important legislation includes the Marine Protection, Research, and Sanctuaries Act of 1972 (Ocean Dumping Act) which has three main thrusts: regulation of dumping, research aimed at finding ways to end all ocean dumping, and the creation of marine sanctuaries. This was followed, 4 years later, by the Resource Conservation and Recovery Act of 1976 (amended by the Quiet Communities Act of 1978), which provides technical and financial assistance for (1) the development of management plans; (2) facilities for the recovery of energy and other resources from discarded materials; (3) for the safe disposal of discarded materials, and (4) regulation of the management of hazardous wastes.

Employment

The factor most affecting employment in the solid waste management field is the Resource Conservation and Recovery Act of 1976, which calls for addition of personnel at local, State, and Federal levels, although the main impact on employment will certainly be at the local government level. Provision must be made for public education efforts, and for making available on-site technical assistance to industries to aid in compliance; and a regulatory system must be developed to insure safe handling, transporting, storing, and disposal of waste. These requirements will increase the need for technical, professional personnel and for inspection and compliance workers.

The number of people needed to collect municipal solid wastes is not expected to change appreciably; due to automation, there may eventually be a slight reduction. However, as salvaging and resource recovery become commonplace, and as the processing of solid wastes becomes automated, personnel will be needed to design, construct, and manage these automated systems. There will be significant additions of scientific and technical personnel working in research and development. Engineers in particular are expected to have the widest range of job opportunities; job openings should expand by about 10 to 15 percent a year through 1982.

Workforce totals for the solid waste management field are expected to increase at about 10 percent a year through 1979, with the rate of increase gradually declining after that.

Occupations

The reader will note some overlap of duties among occupations in the waste management field; this is partly owing to the present lack of standardization of duties.

Occupations in solid waste management include waste management engineers who apply engineering knowledge and skills to all phases of waste management — handling, processing, disposal, and resource recovery. One specialization in waste management engineering that has recently emerged is that of the resource recovery engineer, who focuses on improving waste recovery plans.

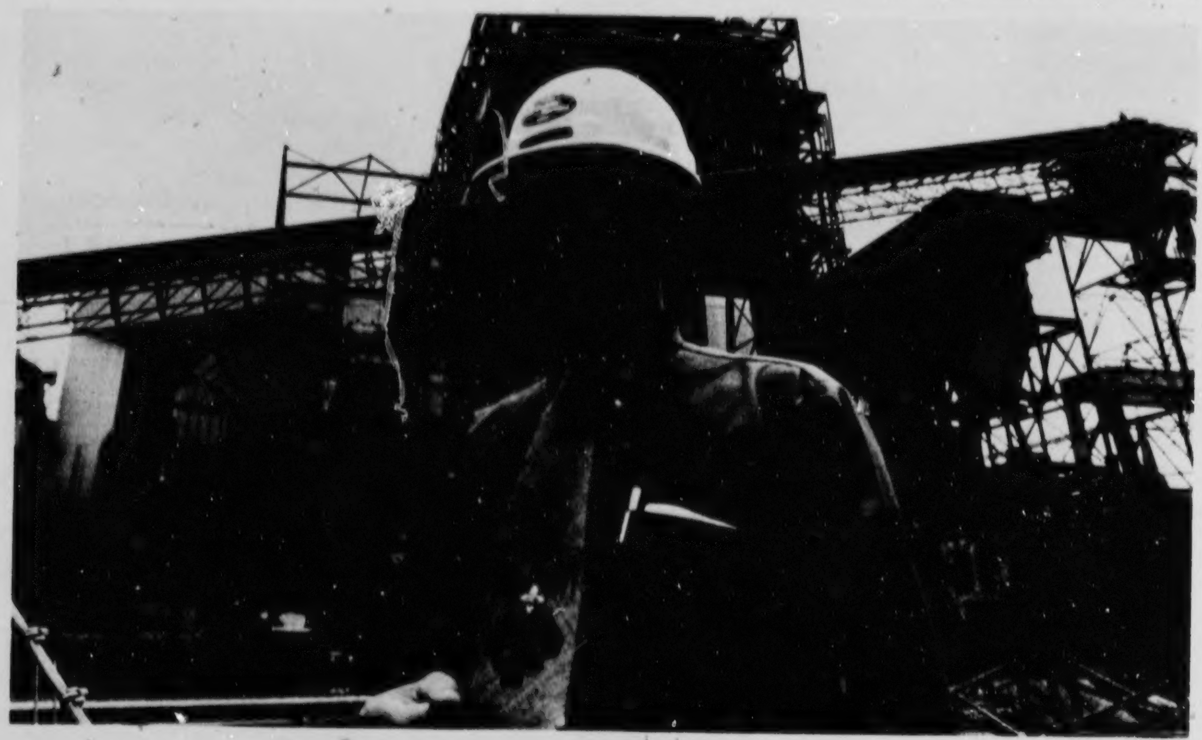
Waste management specialists work on many projects to improve disposal practices and promote the enforcement of rules and regulations.

The collection of solid waste materials is also important. The top level of administration is the refuse collection superintendent. The refuse collection supervisor is immediate supervisor of the crews (refuse collection truck operators) who collect refuse and deliver it to a disposal site.

Refuse Collection Superintendent

The refuse collection superintendent is responsible for directing and coordinating the activities of refuse collection personnel within a major district of a city. Typical work includes directing the preparation of operating reports and records; making studies and analyses of procedures and recommending methods for increasing economy and efficiency; requisitioning equipment and supplies; and making adjustments in assignments to utilize personnel and equipment most effectively.

Difficult complaints from the public are usually handled at this level, as well as requests for changes in service and



resolution of special personnel problems. Refuse collection superintendents also maintain liaison with representatives of other municipal agencies on such matters as enforcement of regulations concerning community sanitation.

Job Requirements

The job requires at least 1 year of experience in a capacity such as refuse collection supervisor. Also required is knowledge of the practices governing the establishment and modification of refuse collection routes; knowledge of the equipment and personnel necessary for effective refuse collection services in a city; and knowledge of budget requirements for refuse collection services.

Opportunities

This job is primarily reached by promotion. Although there will be added opportunities because of population growth, the majority of openings will result from replacement needs.

DOT code: Refuse Collection Superintendent*

Refuse Collection Supervisor

Refuse collection supervisors exercise direct supervision over crews engaged in the collection of refuse and its delivery to a disposal site. Supervisors are responsible for seeing that refuse collection schedules are met; they review operating reports; and they make field inspections of the work. In addition, they have public relations responsibilities, as they handle complaints of all types concerning the collection of refuse. Refuse collection supervisors make crew assignments, see that trucks and employees leave yards promptly at the start of shifts, and assure that crews follow refuse collection schedules and procedures.

The ability to supervise and review the work of a large number of people is important, as is the ability to deal tactfully with officials, employees, and the public. Verbal ability is also needed to review and prepare reports.

Job Requirements

The job is frequently a promotional one, requiring 3 or 4 years' experience in the collection or disposal of municipal wastes. In some situations 1 year of college may be substituted for experience, on a year-for-year basis, to a maximum of 2 years.

Opportunities

Most opportunities are by promotion from refuse collection truck operator and arise from replacement needs, although more workers will be hired as a result of population increases.

DOT code: Garbage-Collection Supervisor* 909.137-014
*As listed in the 1977 DOT.

Refuse Collection Truck Operator

Garbage truck driver
Garbage collector driver

Ultimate disposal of refuse may undergo radical change within the next decade, with sanitary landfills, recycling, and resource recovery facilities increasing. Garbage collection technology, however, is not expected to change to any great extent, and jobs in this type of work will remain basically the same.

In this occupation, workers drive refuse-collection trucks and operate mechanical refuse packing equipment. They usually direct the work of a helper or helpers, and are responsible for inspecting the truck for sufficient gas, oil, and water, proper tire inflation, and condition of safety equipment. In addition, they may prepare routine operating reports, such as fuel used and trip tickets. In some instances

workers are hired as truck operators, not specifically for driving refuse trucks, and may drive other heavy vehicles and perform other related work.

Reasonably good manual dexterity and motor coordination are required, and willingness to work in varying weather conditions. The strength to lift 70 pounds is necessary.

Job Requirements

Typically, the hiring requirement is for 1 year of experience driving a truck carrying a payload of at least 1½ tons, and possession of a class 1 or 2 driver's license.

The job requires knowledge of the operating and maintenance requirements of various types of trucks having a gross vehicle weight of 28,000 pounds or less; good knowledge of vehicle codes and traffic regulations; ability to direct the work of others; ability to prepare routine written reports.

Opportunities

This is a high-volume occupation, offering better than average opportunities because of population growth, increased urbanization, and frequent replacement needs for workers.

DOT code: Garbage Collector Driver*	905.663-010

*As listed in the 1977 DOT.

Resource Recovery Engineer

Most resource recovery still depends on the efforts of householders, office workers, and others at the sources of waste generation. Waste paper and aluminum recovery efforts in particular have been successful. The complex technology for recovery of energy and other valuable resources, however, is still experimental. Many projects have been plagued by design and mechanical problems, cost increases, and delays. Much work remains to be done in the resource recovery field, and a new occupational specialization has emerged—resource recovery engineering.

Engineers in this specialty conduct solid waste resource recovery studies and inspections, promote and assist in the development of resource recovery programs, coordinate marketing studies, and evaluate technology and processes. They inspect and monitor resource recovery facilities and source separation programs, including inspecting facilities under construction and monitoring of operations. Also, they evaluate chemical or mechanical resource recovery technology, including determining process objectives, analyzing reliability, investigating operational characteristics, and carrying out economic studies on process designs and operations. In addition, they develop resource recovery plans by collecting data on resource recovery systems, reviewing and analyzing alternate solutions, and preparing recommendations. They coordinate market studies concerning potential reclaimable wastes; promote resource recovery practices, and meet with agency officials, design engineers, and others to promote technical assistance and advise on technology and processes.

Job Requirements

Requirements may vary for this newer occupation, but they usually include an engineering degree in civil, chemical, mechanical, or waste management engineering, and several years of experience in the solid waste management field at a professional engineering level. An advanced degree may be substituted for a portion of the required experience in some cases.

The work requires knowledge of the principles and practices of solid and hazardous waste disposal and resource recovery systems; and knowledge of Federal, State and local laws, rules, and regulations pertaining to waste management and resource recovery.

This work requires the ability to make critical examinations of engineering plans, specifications, and reports; to prepare clear, technically sound, accurate reports containing findings, conclusions, and recommendations; and to establish and maintain cooperative working relationships with the many people dealt with in the course of the work.

Opportunities

A further specialization of waste management engineering, this job will be increasingly in demand as resource recovery technology advances as an alternative to landfill. The number of opportunities may be limited for the immediate future, except in research and development, because many of the technologies are now being tried out for the first time on a commercial scale. Opportunities will be in the most densely populated areas.

Sanitation Inspector

Extensive plans for recycling and resource recovery, legislation to end open dumping, energy shortages, and inflation have not significantly lessened the problem of refuse and litter in both our urban and rural communities. Control in this area for the foreseeable future will still depend on surveillance and enforcement activities.

Sanitation inspectors investigate and resolve problems of unsightly litter, weeds, and illegal dump conditions in a community. They make periodic inspections of such sites and initiate corrective action, at times attempting to persuade property owners to voluntarily correct conditions. Related duties include receiving and investigating complaints of unsightly or hazardous conditions; determining if municipal building, fire, or other code violations exist; issuing notices of violation and notices to abate; reinspecting property for compliance; preparing case material when legal action is required; promoting community interest in eliminating and controlling unsightly conditions; and coordinating cleanup projects.

Job Requirements

There is usually no educational requirement beyond graduation from high school and it is not required for all jobs. Work experience is necessary — usually 1 or 2 years in community public contact work, field investigation, inspection, or enforcement.

A driver's license is required.

Opportunities

Increased concern for environmental quality in recent years has prompted establishment of more positions such as this and all indications are that the trend will continue. There may at times be strong competition for these jobs, partly because of the fairly broad experience requirements. Community college courses in environmental sanitation, waste management, and related courses may increase an applicant's competitiveness.

DOT code: Resource Recovery Engineer*

Waste Management Engineer

Among the many career choices in engineering in the pollution control field is waste management engineering. Engineers in this specialization review engineering drawings, plans, and specifications; conduct site inspections of disposal facilities; and consult with management, professional, and technical personnel in order to make recommendations regarding methods and location for waste handling, processing, disposal, and resource recovery systems.

In addition, waste management engineers prepare reports of recommendations on permit applications for waste facilities, and provide technical assistance to various government agency personnel on the development and operation of waste and resource recovery facilities. Most engineers in this field also plan and conduct research projects for the development of new methods and technologies for the treatment of wastes.

Waste management engineers also investigate complaints regarding waste disposal conditions and make recommendations for prevention or abatement. They conduct surveillance of waste processing and disposal practices in an assigned area and enforce waste management laws and regulations.

Engineers must possess the ability to review and interpret engineering plans, estimates, and specifications. They must also be able to evaluate findings, make recommendations, and establish and maintain working relationships with many professional and technical people.

Job Requirements

The usual hiring requirement is for a bachelor of science degree with major work in engineering, and 1 or 2 years of engineering experience in waste management or process control engineering. A master's degree in waste management engineering may be substituted for the experience requirement. Entry as a junior engineer may be possible without professional work experience.

The work requires knowledge of waste management and public health engineering; treatment and disposal of solid and hazardous waste; programs for resource recovery; and design, construction, and operation of waste management facilities.

Opportunities

New, comprehensive waste management legislation points to greatly increased opportunities for professional engineers in this field. Many jobs will be in research and development, particularly in resource recovery, energy recovery, and other alternate solutions to landfill and ocean dumping.

DOT code: Pollution-Control Engineer* 019.081-018

*As listed in the 1977 DOT.

Waste Management Specialist

The waste management specialist is a professional in the waste management field and differs from the waste management engineer in that the work does not include basic research and design activities.

Specialists work on projects to improve solid waste disposal practices and promote the enforcement of rules and regulations. They plan and participate in surveys and investigations of solid waste disposal practices; inspect sanitary landfill operations; and confer with municipal and other agency health personnel and with sanitary landfill operators to improve disposal practices and to promote enforcement of established laws.

Other job duties include coordinating the program registration of solid waste operators; investigating complaints and preparing complaint reports; and preparing investigative reports of solid waste management matters containing findings, conclusions, and recommendations. Waste management specialists may appear in court as expert witnesses.

Job Requirements

The minimum educational requirement is graduation from college with a bachelor's degree in the chemical, biological, or environmental sciences, or in civil, chemical, mechanical, sanitary, or other related field of engineering. At least 1 year of related experience in solid waste management is usually required for entry at the full professional level.

The work requires knowledge of practices in the field of solid waste management; of laws and regulations in the field; and the ability to establish cooperative working relationships with officials, public and private agency representatives, and the public.

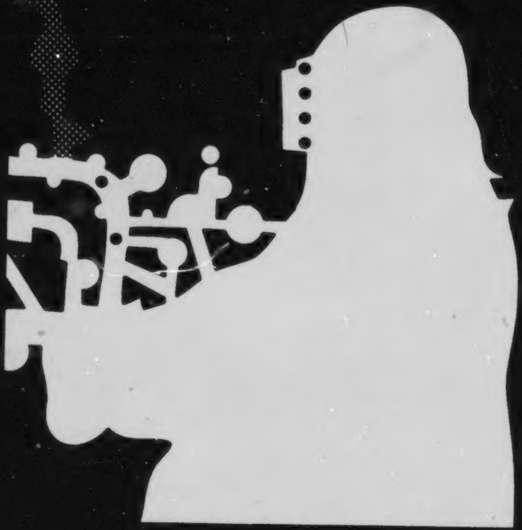
A driver's license is required.

Opportunities

Projections are for continued increases in opportunities in this occupation, due to new waste management legislation now in effect. Another factor contributing to the demand is the increasing quantity of residential and industrial waste.

DOT code: Waste Management Specialist*

Radiation Control



The increase of manmade radiation poses a danger to our health. The principal adverse effects that radiation can have on human health are genetic disturbances and cancer.

We all receive radiation from natural sources over which we have little control. Our remaining exposure comes from medical and dental X-ray machines; fallout from nuclear weapons testing; uranium mines; mills and fabrication plants; nuclear power generating and fuel-reprocessing installations; and various electronic devices. Hospitals and laboratories use radioactive isotopes in basic research and patient diagnosis and treatment. Construction materials with radioactive properties have been used for homes, schools, factories, and other structures. This is compounded by the fact that we know very little about the long-term effects of repeated exposure to radiation at low levels. It is generally accepted that any amount of radiation, however small, can cause damage to genetic cells and hence cause an indeterminate number of undesirable mutations. Such genetic damage is believed to be cumulative.

This background establishes why nuclear energy and radiation are, in 1978, the most controversial area of the environmental control field. Primary nuclear energy concerns are (1) permanent disposal of nuclear wastes, (2) decommissioning of nuclear plants, (3) plant safety and security, and (4) the danger of wide-scale use of plutonium (potential nuclear explosive use).

The lack of permanent, safe storage or disposal for high-level radioactive wastes from nuclear reactors has become a major concern in recent years; some of these wastes must be isolated for hundreds or thousands of years. Radioactive wastes are now temporarily stored in tanks at commercial and government nuclear facilities. Large quantities of radioactive wastes from nuclear weapons production are stored in tanks and bins at government installations in Idaho, South Carolina, and Washington.

Responsibility for radiation safety, according to the Senate Governmental Affairs Committee, is scattered and uneven, resulting in jurisdictional disputes and regulatory confusion. The Committee found that eight executive departments, two independent commissions, and five separate agencies have at least potential authority to regulate radiation safety.

Legislation

The Atomic Energy Act (1954) regulates the release of radioactive waste into the environment. The main categories of waste are (1) those which must be within established radioactive content limits; and (2) those wastes which are not discharged but which are so potentially hazardous as to require special care. Of the latter, those which are "other than high-level" are generally buried according to specified regulations, and "high-level wastes" are temporarily stored awaiting determination of suitable permanent disposal. No high-level wastes have been permanently stored as yet, although the Department of Energy has responsibility for disposal. No sea disposal of radioactive wastes by the United States has been conducted since 1970.

During the 1970's other legislation was passed. The Marine Protection, Research, and Sanctuaries Act of 1972, also called the Ocean Dumping Act, controls the ocean dumping of materials that adversely affect human health and welfare, including radioactive materials. The Hazardous Materials Transportation Act of 1974 regulates the transportation in commerce of hazardous materials, including radioactive materials, by all transportation modes. The Toxic Substances Control Act of 1976 exercises authority over the manufacture, processing, distribution in commerce, use, or disposal of chemical substances and mixtures, including special nuclear material, or byproduct material.

Employment

Increased awareness of potential radiation danger to the public from a multitude of sources around us, and increased use of X-ray and radiation technology in the medical and dental fields, point to greater opportunities in the future for health physicists, radiation technicians, radiation protection specialists, and of course for medical specialists such as X-ray technologists.

The nuclear energy field has an extremely high concentration of engineers, scientists, and technicians, making up nearly half of the workers in the nuclear power industry. Many of the scientists and technicians work in the research and development area of the nuclear energy field. Opportunities for nuclear energy plant personnel will be determined by the number of such plants built, and that is very uncertain at this time. California, for example, has a nuclear safeguard law which specifies that no new nuclear power plants can be built until the State Energy Resources Conservation and Development Commission certifies that the Federal Government has found a proven method of safely disposing of nuclear waste material. National growth projections for the nuclear power industry have been revised downward on two separate occasions in the last two years.

Occupations

A number of professional occupations are found in the area of radiation safety and control. Health physicists perform research, consultation, and inspection work in connection with radiation safety. Emergency services radiation coordinators implement and coordinate radiological defense and safety programs. Responsibility for radiation safety at nuclear power generating plants rests with the radiation protection engineer.

Radiation protection specialist is another occupation related to radiation safety. These specialists test X-ray machines and fluoroscopes for safe operation and certify X-ray personnel. Other radiation monitors, or technicians, insure that personnel, plant facilities, and work environments are free from radiation contamination. They measure intensity and identify types of radiation in working areas. They also collect samples and collect and analyze monitoring devices worn by personnel to measure individual exposure to radiation. Usually radiation laboratory technicians perform the tests and analyses on the samples.

Radiation safety at nuclear power plants requires the work by personnel to measure individual exposure to radiation. These technicians collect samples, perform standard analyses and evaluate the results, and prescribe chemical treatment to meet safety standards. They are also expected to maintain their equipment and instruments. In some areas, radiological instrument technicians work full-time in the operation, maintenance, and repair of radiological detection equipment.

Chemical Radiation Technician

Nuclear reactor technology has been under development in the United States for more than 45 years. During this time the knowledge necessary to protect public health and safety has advanced along with the technology itself. But even today, radiation safety at nuclear power plants, as well as concern for disposal of radioactive wastes, is an everyday news item.

Among the radiation protection personnel at nuclear power plants are chemical radiation technicians, who perform tests and analyses and monitor radiation. They collect samples of water, solids, or gas; perform standard chemical or radio-chemical analyses; evaluate results and prescribe the necessary chemical treatment or adjustments to maintain established control limits.

Monitoring duties include assisting in setting up equipment for chemical or environment monitoring investigations; performing monitoring surveys to determine radiation levels; carrying out decontamination procedures when required; monitoring plant waste for radionuclides or gross activity; and prescribing waste discharge rates.

Much of the work of the chemical radiation technicians is involved with equipment and instrumentation. They maintain chemical instrumentation sensing elements and service sampling systems equipment; calibrate and service chemical and radiation detection instrumentation; and assist in diagnosis and repair of other instrumentation and plant process equipment. Chemical radiation technicians also provide training and direction to other plant personnel on radiation protection and the water control treatment program. They record test results and monitoring data, and prepare reports of tests and operating conditions.

In addition to strong scientific and mechanical interests, persons interested in this work should have good verbal and numerical abilities.

Job Requirements

Normally the hiring requirement includes a high school education, supplemented by specialized technical study in nuclear physics and several years of experience as a chemical laboratory technician. The job is frequently acquired through promotion, as many power generating plants also employ chemical lab technicians.

The work requires knowledge of the principles of chemistry and basic atomic and nuclear physics; the theory of chemical and radiation detection instrumentation; laboratory procedures and equipment; decontamination procedures; and principles of radiation protection as related to a nuclear generating plant.

Opportunities

Demand for this occupation has increased steadily over the past few years, with the increase in the number of nuclear power plants. Recent controversy over nuclear plants, however, makes it uncertain both that they will be built at the same pace and that in-job opportunities in nuclear plants will continue to increase.

DOT code: Chemical Radiation Technician*

Emergency Services Radiation Coordinator

Although the era of the backyard bomb shelter has passed, and stockpiling of supplies against the eventuality of "the bomb" has fallen from fashion, activity at various government levels goes on. The emphasis, however, has now shifted slightly from concentration on preparedness for nuclear warfare to preparedness for nuclear accidents and concern for radiation safety. Typical of the jobs concerned with implementing and coordinating radiological defense and safety programs is that of the emergency services radiation coordinator.

Radiological coordinators work as staff assistants or field representatives, consulting with, advising, and assisting state and local agencies and organizations with the ongoing maintenance of radiological defense programs. They also assist local agencies in complying with regulations having to do with distribution of Federal and State radiological equipment. Coordinators are also extensively involved in training—preparing and developing radiological training programs and conducting such training courses. They may also be responsible for recruiting and training community volunteers for radiological defense operations in the field. In the event of any natural or war-caused disaster posing a radiological threat, workers would assist in coordinating emergency defense operations.

The work requires a combination of technical knowledge and communications skills: It calls for a candidate with the personality to be an effective trainer, as well as one who has extensive subject matter knowledge in the field of radiation to develop original training programs.

Job Requirements

The job requires graduation from an accredited college with a major in the physical sciences or related field, and 2 or more years of work experience, either in radiological safety work or as a radiological equipment technician. Most State and local agencies, which are the major employers in this work, will also accept additional work experience as a substitute for the required education, on a year-to-year basis.

Knowledge is required of radiation detection; rules and regulations concerning radiation source licensing; and principles and methods of group training. Interested persons should also be familiar with State and local civil defense and disaster activities

Opportunities

This is not a high volume job, nor is any dramatic change in the number of job opportunities anticipated. Most openings will result from employee promotions or other normal turnover.

DOT code: Emergency Services Radiation Coordinator*

Health Physicist

Radiation physicist

The work of the health physicist is somewhat similar to the work done by the radiation protection specialist, in that both are concerned with radiation safety. The radiation protection specialist inspects X-ray equipment and certifies X-ray personnel, and is usually supervised by a health physicist. Health physicists perform research, consultations, and inspection work in connection with radiation sources and radiation-producing devices used in high-intensity or unevaluated applications. Typical research projects include developing inspection standards, radiation exposure limits for personnel, safe work methods, and decontamination procedures.

The work of the health physicist varies, however, depending on the work setting, which may be an enforcement and control agency, a hospital, a research facility, an industrial establishment, or a consulting firm. Generally, though, in addition to consulting and research work, health physicists devise and conduct training and monitoring programs concerning radiological health hazards and sources of ionizing radiation.

When working for an enforcement and control agency, typical job duties for a health physicist would include conducting surveys of high-energy X-ray installations, teletherapy units, radioisotope laboratories, and similar facilities; and determining compliance with radiation licensing requirements and with provisions of radiation control laws and regulations.

Many health physicists develop and adapt instrumentation for the detection and measurement of radiation; review plans and specifications for installations using or producing ionizing radiation; and advise on the design and modification of protective devices. They also evaluate emergency incidents involving radioactive spills, losses, and suspected or accidental radiation exposure. In these instances they give professional advice on handling; they decide on the corrective action necessary to control the hazard and prevent its recurrence. Health physicists may also advise on the transfer and disposal of radioactive materials such as cobalt and radium, and insure that such transfer or disposal is done according to laws and regulations. In many work situations they prepare and conduct lectures and training programs for medical, industrial, or research personnel in the safe use and handling of radioactive materials and radiation-producing machines.

Health physicist work requires a wide range of aptitudes, interests, and skills. Certainly the interest in science and engineering must be strong. Good mathematical skills are essential, as well as verbal and communication skills. The work is highly responsible, affecting as it does human health and safety, and it requires analytical and decision-making ability.

Job Requirements

The minimum educational requirement is graduation from an accredited college with major work in physics, engineering, or in the physical or life sciences. Many employing establishments hire only at the experienced level, usually asking for at least 2 years of professional health physics experience (this excludes routine radiation monitoring or

surveying). Other employers have a junior or assistant level, permitting hiring of degree applicants without professional work experience. In some instances graduate work, or successful completion of a 1 year Atomic Energy Commission fellowship, may be substituted for all or part of the experience requirement.

The work requires a thorough knowledge of the theory and practice of health physics and radiation protection; also, knowledge of the design of shielding for protection against radiation; radiation dosimetry and the theory and methods used to measure radiation levels; instrument methods and design; evaluation of radiological hazards involved in medical, dental, industrial, and laboratory work; and the biological effects of ionizing radiation. Knowledge of radiation control laws and regulations, atomic and nuclear physics and chemistry, and radioactive waste disposal techniques are also necessary.

The work may require a health physics certification and eligibility for security clearance.

Opportunities

Opportunities should remain good for persons with professional work experience in health physics, and should improve for inexperienced graduates because the trend toward structuring junior level jobs is increasing. There are relatively few health physicists employed in private industry and as consultants—the majority of positions are with government agencies, hospitals, and in research and teaching. Many jobs in research and in teaching require graduate degrees.

DOT code: Health Physicist 079.021-010

Radiation Laboratory Technician

Although there has always been naturally occurring radiation in our world, 20th century technology has introduced manmade radiation into our environment as well. Public safety considerations make it necessary that various environmental components be monitored; thus we have the need for workers such as the radiation laboratory technician, as well as other radiation protection occupations.

The radiation laboratory technician is usually employed in a radiological health laboratory and is concerned with performing routine and special preparation, counting, and calculation operations on samples delivered for assay. The technician prepares proportioned samples of water, silt, earth, vegetation, and special environmental samples for the counting of radioactivity; keeps records of samples prepared; performs routine maintenance on counting equipment; and prepares requests for other maintenance and repair when needed.

The radiation laboratory technician also performs check counts and runs calibration curves and background counts on laboratory equipment, using established schedules and procedures; assists with calculations concerning samples processed; and prepares sampling, survey, and assay reports covering findings. The work may involve driving a mobile laboratory to survey sites, operating the mobile lab equipment, and assisting in collecting and processing samples in the field.

We can readily see from the job duties that a number of interests and aptitudes are important to success in this work, including an interest in scientific and technical work. Mathematical ability is certainly important, as well as the interest and aptitudes necessary for operating and maintaining a variety of laboratory instruments and equipment. The job also calls for the ability to work according to precise procedures and standards, and the ability to record scientific data accurately.

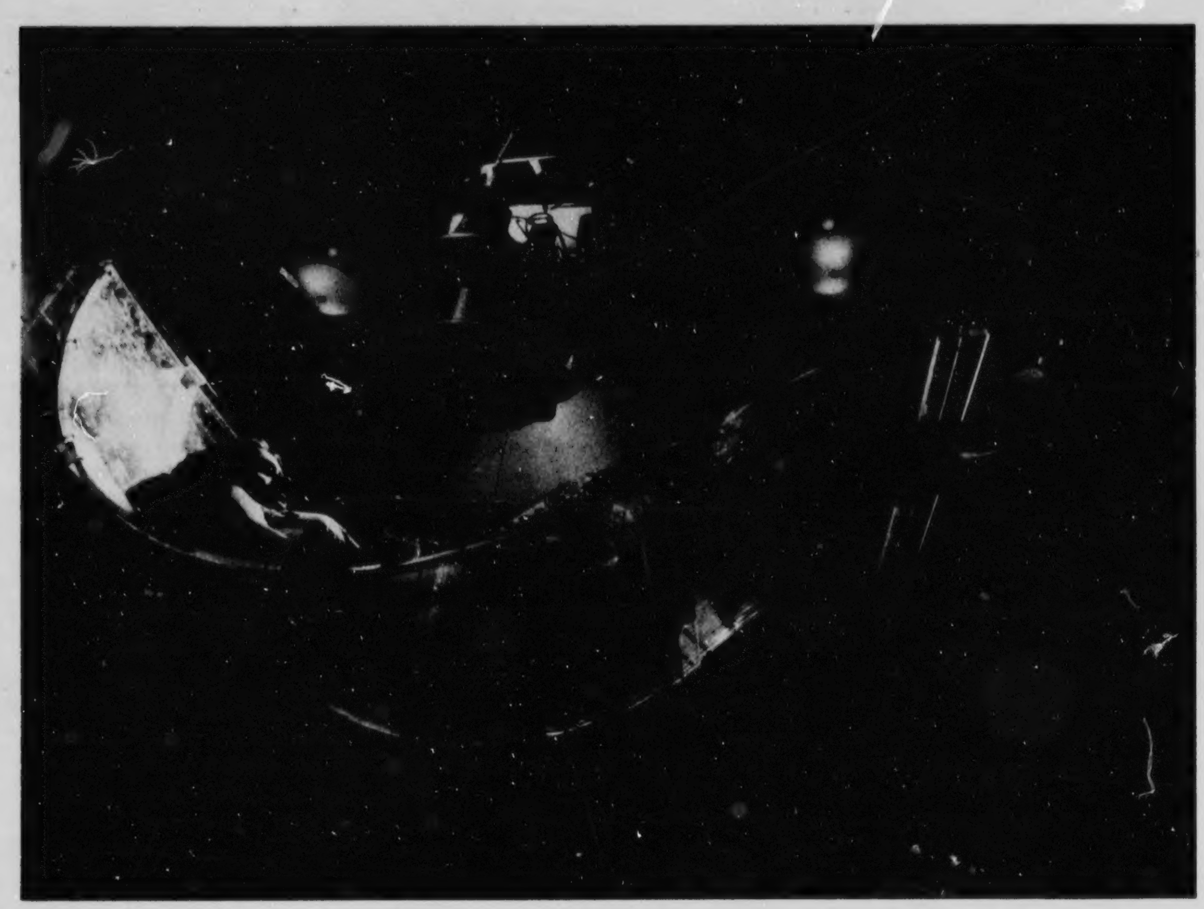
Job Requirements

The minimum education requirement is usually the completion of a course in radiation technology. Work experience may be required, for example at least 1 year in a radiation or chemical laboratory, in work involving routine counting and calculation operations on samples.

Basic knowledge is necessary of the equipment and techniques used in performing radiological assays, and of the methods used to plot data and prepare graphs, including the math involved. A driver's license is usually required.

Opportunities

Job opportunities are best in the public sector, with local and State agencies, where technician level jobs may be structured so as to have promotional ladders to professional level. Usually a combination of work experience and further education is required for such advancement.



Radiation Monitor

Health physicist technician

Early in this century many hundreds of men and women were employed in watch factories in the United States and Europe, hand painting watch dials with radium paint. That they would suffer from radium poisoning as a result of this work was not a concern at the time. Even today the General Accounting Office of the U.S. Government estimates that 22,000 Americans develop leukemia, other forms of cancer, and serious genetic disturbances each year because of exposure to radiation. It is obvious, therefore, that monitoring of radiation should take place in industrial environments where workers are likely to be exposed to danger.

Radiation monitors are responsible for insuring that personnel, plant facilities, and work environments are free from radiation contamination. Using a variety of detection devices, they measure intensity and identify types of radiation in working areas. They also collect air samples to determine airborne concentrations of radioactivity and collect and analyze monitoring devices worn by personnel (film badges and pocket detection chambers) to measure individual exposure to radiation.

Usually working under the direction of health physicists, they take smear tests in work areas when contamination is suspected; inform supervisors when individual exposures and area radiation levels approach permissible limits; and recommend work stoppages in unsafe areas, post warning signs, and rope off contaminated areas. Under direction, they calculate the amount of time personnel may be exposed safely to radiation in work areas. They also instruct personnel in radiation safety procedures and demonstrate use of protective clothing and equipment.

Anyone interested in this work should like technical and scientific work, including working with instruments, and equipment in a laboratory and industrial work setting.

Job Requirements

Entry work in radiation monitoring usually does not require education beyond high school, particularly if the applicant has taken high school science courses; most training is on the job. In many cases people doing this work are hired in another capacity, such as lab, quality control, or production work. Frequently radiation monitoring is only part of the job because there is not sufficient work in that one capacity to occupy a person full time. Larger industrial establishments may hire full-time radition monitors, either trainees or experienced workers in that field.

Opportunities

Recent, growing concern for low-level exposure to radiation points to increasing work activity in the areas of surveillance and monitoring.

DOT code: Radiation Monitor 199.167-010

Radiation Protection Engineer

Chemical radiation protection engineer

The Manhattan Project—the nation's effort during World War II to develop the atomic bomb—included the construction of the large Hanford reactor complex on the Columbia River near Richland, Washington. Unlike the procedure in commercial power reactors, river water was passed directly through the reactor and returned to the river. Even during the earlier days of the Manhattan Project the possibility of the environmental effects of the radioactivity and heat was recognized.

Today, responsibility for radiation safety at a nuclear power generating plant rests with the radiation protection engineer, who supervises a number of chemical radiation technicians and is responsible for monitoring the chemistry, radio-chemistry, and radiation protection programs at a nuclear power plant. Radiation protection engineers evaluate data for chemical analysis of reactor plant water, secondary plant water, and other supporting water systems to determine compliance with regulations on radioactive content and corrosion control. They prepare many reports, on a regular basis, covering plant operation, radioactive waste releases and shipments, and the environmental monitoring analysis program.

At times they deal with equipment suppliers to obtain information on new equipment, and with regulatory agency personnel for the review of station radiation protection data. Also, they investigate, analyze, and provide solutions to problems concerning water systems corrosion, radio-chemistry, and radiation protection.

The combination of supervising and technical expertise necessary to the job calls for a variety of interests and aptitudes, including high verbal ability, both oral and written. The engineer must be able to supervise and train others, as well as delegate responsibility. The work requires a strong interest in science and engineering, of course, and willingness to accept the responsibility of a job that has strong public safety implications.

Job Requirements

The preparation needed is a bachelor's degree in chemistry or engineering and 2 years' experience in nuclear plant chemistry and radiation protection. Entry at the assistant level may be possible, as most generating plants also employ assistant engineers. In that case professional work experience in the field would not generally be required.

Opportunities

Opportunities have been excellent for the last few years because of the increase in construction of nuclear plants. The prospect for growth and increase may not be as encouraging in the near future, however, as a result of the nuclear plant controversy. The nuclear power industry has traditionally employed an exceptionally high percentage of engineering and scientific personnel.

DOT code: Radiation Protection Engineer*

Radiation Protection Specialist

In today's media, most of what we read and hear about radiation safety has to do with nuclear power plants—where they are sited, if they should be built, operational danger, or waste disposal problems. Throughout the country, however, there are many thousands of radiation-emitting installations of another kind, such as the X-ray tubes and fluoroscopes used in medical, dental, industrial, educational, and research facilities. They must also be monitored for safe operation.

Radiation protection specialists are concerned with the safe and legal use of such equipment. Typically, the radiation protection specialist works for a local government radiation control unit, in a hospital under direction of a physicist or physician, for a State health department, or for a Federal Government agency.

People in this line of work test X-ray machines and fluoroscopes at specified intervals, using specialized test equipment, meters, and procedures for elements related to the safe operation of the equipment. They also review plans and specifications of proposed X-ray installations and require changes of layouts and shielding to conform to legal requirements and accepted radiation safety practice.

Radiation protection specialists provide consultation to physicians, dentists, and X-ray personnel on proper practices, procedures, and legal requirements in the use of radiation equipment; and inspect operating licenses and operating procedures to determine the competence of operators to conform to legal requirements. Specialists may be called upon to demonstrate proper exposure techniques to improve procedures and minimize the amounts of radiation delivered to patients.

The job requires a combination of technical and public relations abilities, since the specialist must have extensive knowledge of equipment operation and also deal constantly with professional and technical personnel. High verbal ability is needed, both oral and written.

Job Requirements

Radiation protection specialist is not generally an entry job, open to persons without related experience. Depending on the hiring agency, the experience requirement may be for 2 or more years of experience as an X-ray technologist, including experience in supervision of X-ray technologists; or for 2 or more years' experience in operation, repair, testing, or inspection of radiation emitting equipment, or monitoring the use of radioactive materials. Possession of a valid certificate in diagnostic radiologic technology may be necessary.

The required education also varies; the minimum is 2 years in an accredited college with major work in the physical or life sciences or engineering. Some employers require a 4-year degree in one of the same subject areas.

The job requires knowledge of current techniques of clinical radiography; types of equipment used or related to medical radiography; effect of voltage, current, and filtration on radiographic results; effect of film processing variables; rules and regulations governing radiation use; principles of radiological health including methods of measurement and effects of ionizing radiation; radiation measuring instruments; and physics and chemistry. The work requires a driver's license and willingness to travel.

Opportunities

Employment opportunities are good for those possessing the required education and experience; demand and growth for the occupation are steady if not dramatic. There has been tremendous increase in the amount of equipment and volume of licensed operators, but funding has not permitted staffing increases of radiation protection specialists in the same proportion; internal adjustments in radiological health units have been necessary to account for these increases.

DOT code: Radiation Protection Specialist*

Radiological Instrument Technician

Radiological equipment inspector

Monitoring of radiation is done by government agencies at all levels, by consulting firms employed by industrial establishments, and by technical employees of industrial and manufacturing plants. Much of the monitoring depends on a variety of instruments, apparatus, and equipment specifically designed for radiation detection and measurement.

Radiological instrument technicians operate, maintain, and repair radiological detection equipment such as Geiger counters, ionization chambers, dosimeters, and other special devices. The work of these technicians also includes performing leak tests of radioactive sources, and explaining and demonstrating the use of radiological detection equipment. At times technicians must modify instruments to improve their reliability or efficiency. In addition to repair and operation duties, the work includes preparation of reports on the performance characteristics of detection instruments.

Others performing this work may be concerned with inspecting and maintaining radiation detection equipment in monitoring stations and shelters only. They make periodic inspections of monitoring stations and shelter operations, and operate and calibrate laboratory and portable electronic detection instruments.

Both mechanical and mathematical aptitude are necessary for success in this work; in addition to the operation and repair work, technicians must be able to use schematics and prepare basic working drawings and specifications.

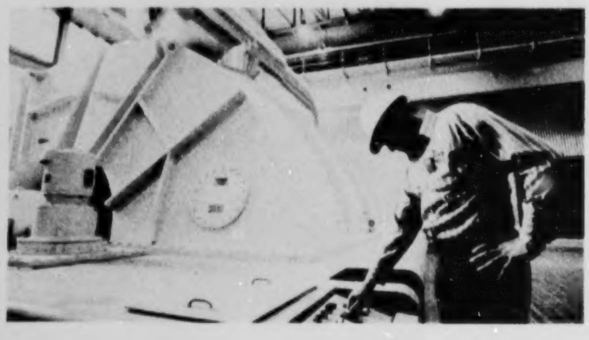
Job Requirements

The entry level technician job usually requires 1 to 2 years' experience operating, calibrating, maintaining, and modifying electronics equipment. Although formal electronics training may not be specified as a requirement, the work does require knowledge of electronic theory and construction of electronic equipment. Also, the technician must have basic knowledge of physics and nuclear theory, as well as the proper methods for handling radioactive sources.

Opportunities

Most of the jobs are found with government agencies, local, State, or Federal, and although there is no acute shortage of applicants there will continue to be opportunities because of turnover and promotions. (Most agencies have several levels for the radiological technician classification: The higher levels perform the more difficult work and also supervise trainee and lower level workers.)

DOT code: Radiological Instrument Technician 710.281-026



Other Environmental Activities

It is not the purpose of this *Guidebook* to describe all of the occupations affected by environmental activities. The problems of the environment are so complex and far reaching that many different occupations are involved in finding solutions.

Specialists in many fields concentrate on environmental problems: Sociologists may see pollution as a social problem; physicians, as a medical problem; teachers, as an educational problem; and so on, for many other occupations.

Technicians, craftworkers, laborers, and clerks are also affected by pollution-control or other environmental activities. For example, workers in the automobile repair industry install and maintain pollution-control devices. Factory workers manufacture electronic instruments for measuring pollutants. Computer programmers and statisticians compile and interpret scientific data. Laborers plant trees, build trails, and maintain parks. The list is endless.

Occupations

This chapter describes some occupations, though primarily environmental, not necessarily identified with a specific area of control such as water, wastewater, air, or noise. These occupations can be found in more than one area of environmental activity and, to avoid repetition, are described in this chapter.

Today, environmental lobbyists promote legislation to save natural resources and try to influence legislators. Environmental lawyers interpret laws and court decisions and advise clients concerning many problems related to the environment. Economists predict the effects on the job market of enforcement of environmental regulations.

Other occupations include industrial hygienists and industrial-hygiene engineers who work to safeguard workers by controlling and improving working conditions. Some physicians specialize in occupational disease and medical problems related to pollution. The occupational-health nurse provides nursing services and helps the workers to protect their health.

In other areas, industrial-waste chemists, chemical-laboratory technicians, engineering technicians, and a small number of laboratory and engineering aides work in pollution control and other environmental programs.

Chemical-Laboratory Technician

Chemical-laboratory technicians assist chemists by maintaining equipment, weighing and mixing chemicals, and performing routine physical and chemical tests.

Chemical-laboratory technicians work in many pollution-control areas. These technicians usually do not collect samples in the field, but stay in the laboratory and run tests on samples collected by others. For example, air technicians send to the laboratory soiled filter papers with samples of car exhaust or smokestack emissions, bottles containing dust settled from the air, and tubes of chemical solutions to test for sulfur dioxide or nitrogen dioxide. In these tests, laboratory technicians calculate how much of a pollutant is present in the air. They make corrections for temperature and air pressure, using mathematical formulas and tables.

Technicians, by bench and machine analysis, test these samples and others, including soil, water, sea water, industrial waste, and sewage. A bench analysis is done at a chemist's bench, by a technician using a sink, chemical solutions, glassware, and gas burner. Machine analysis requires inserting samples into an electronic machine and reading the results. Sometimes technicians prepare the media and set up the equipment for bacteriological tests to be performed by the biologist or microbiologist.

Chemical-laboratory technicians set up, adjust, and operate laboratory equipment and instrumentation such as microscope, centrifuge, agitator, scales, oven, spectrophotometer, gas chromatograph, and other equipment in order to analyze the samples. They check the markings on instruments by testing with samples of known composition and draw graphs to show any corrections that need to be made in an instrument's readings.

While using delicate instruments and glassware, they are expected to avoid unnecessary breakage and waste. They must be able to follow directions (written and oral), obtain reliable results, and record them accurately and legibly.

Technicians may be required to stand for long periods of time in the laboratory and are sometimes subject to unpleasant odors, fumes, and toxic substances. There is danger of burns and exposure to fumes; however, safety precautions are taken.

Job Requirements

Most employers consider graduation from high school supplemented by 2 years of college-level courses in chemistry or the biological sciences a good background for working in a laboratory. In some cases, a portion of the educational requirement may be met with an equivalent combination of training and experience. On the other hand, it is not unusual for someone with a baccalaureate degree in chemistry to work as a technician.

Employers stress the importance of technicians having a good foundation in the fundamentals, including general chemistry, descriptive inorganic chemistry, organic chemistry, and quantitative and qualitative analysis. In addition, mechanical skills are essential: learning to use the various tools, designing and constructing equipment, learning simple electronics, and troubleshooting equipment problems. Many graduates with an associate arts degree continue to work toward a baccalaureate degree while employed.

In a treatment plant, the technician should also have a good knowledge of the unit processes used; he/she should know industrial waste characterization and quantity evaluation, theory and techniques of qualitative and quantitative environmental chemistry, instrumentation and analytical techniques; should have practical experience in modern laboratory methods, techniques, and equipment, and skill in the proper use of the various kinds of laboratory equipment.

Opportunities

Most graduates of 2-year programs in chemical-laboratory technology are employed in private industry and some are with engineering and research firms. A small number of these graduates find work in treatment plants and in government agencies. A basic education in chemical-laboratory technology prepares the graduate to work in any laboratory setting.

With experience, a technician could advance to higher level duties within the laboratory. A technician with a bachelor's degree could advance to a professional level or perhaps become a supervisor.

There should continue to be a demand for qualified chemical-laboratory technicians in private industry, envi-

ronmental engineering and research firms, health agencies, treatment plants, and there should be limited openings with government agencies.

DOT code: Chemical-Laboratory Technician	022.261-010

Engineering Aide

An engineering aide performs simple technical tasks and manual work either with a field survey party or in a drafting room, office, or laboratory, under supervision of an engineer, drafter, or technician.

An aide may assist in determining elevations and laying out construction sites, measure distances between survey points, set stakes, and cut and clear brush from the line of survey. An aide often performs manual tasks such as carrying tools, stakes, and other equipment to the work site.

In the drafting room or office, the aide may trace maps and plans, copy notes, and make simple engineering computations. Aides also perform simple office duties such as filing plans and specifications, answering the telephone, and running errands.

A person in this work should be physically capable, have good eyesight, be able to follow instructions, and be dependable. Good eye-hand coordination and finger and manual dexterity are important to perform both drafting and field work.

Accuracy, attention to detail, and the temperament to perform routine, repetitious work are required.

Job Requirements

The aide is usually a high school graduate and receives on-the-job training in specific duties. In high school, mathematics, science, and drafting are valuable courses and provide a good foundation for a person interested in this type of work. Shop courses are also useful.

There are many technical courses available in vocational-technical schools and junior or community colleges that would be helpful to a person wanting to enter this field.

Usually, no experience is required. Workers can often learn these duties in a few months through on-the-job training.

Opportunities

A very limited number of engineering aides are employed by engineering firms, water purification plants, wastewater treatment plants, and government agencies.

With experience, an aide can sometimes advance to technician level duties. In most cases, however, additional technical training is required.

DOT code: Surveyor Helper	869.567-010
Drafter, Assistant	017.281-018

Engineering Technician

Engineering technicians assist professional engineers in a variety of office and field work related to pollution control projects. These technicians apply technical engineering skills to various projects, such as the preparation and review of plans and specifications for the construction of water distribution systems, swimming pools, purification plants, and wastewater treatment facilities. They work on projects dealing with large ecosystems, or they may specialize in one area such as air, noise, or water pollution control.

Beginning technicians perform limited measuring, computing, drafting, plan review, and inspection duties. For example, technicians review construction details such as sizes of units, capacities, length of pipelines, unit locations, and other information. They compute quantities of materials required and costs of repairs.

Other office duties include maintaining various records related to inspections and progress of projects, answering inquiries concerning technical details of the work, and filing construction plans, blueprints, and other documents.

In some positions, engineering technicians work outside much of the time. For example, they conduct stream surveys and collect water samples, record flow measurements, set up sampling equipment, and collect other water pollution control information. Sometimes they conduct field surveys and set stakes and monuments in preparation for construction projects. They may serve as surveyor helpers on a survey team or even perform manual labor in clearing brush or weeds.

Other duties include such activities as inspecting public water supplies, investigating complaints of pollution or environmental crises, like a fish kill, or testifying in court concerning pollution problems. In some positions, technicians assist in training water and wastewater-treatment-plant operators.

A person in this work should have an aptitude for mathematics and science and enjoy technical work. Attention to detail with a high degree of accuracy is also important. This work could require some travel.

Communication skills are essential in working with engineers, other professionals, and the public to explain pollution control requirements and to answer questions.

Job Requirements

Technician positions require varying combinations of education and experience. In some cases, 2 years specialized experience in basic engineering meets the minimum requirement. Other employers require the completion of as many as 2 years of college with basic courses in engineering and drafting and, in addition, 2 years of experience in drafting or engineering.

In high school, courses in mathematics, science, and mechanical drawing are important. In addition, specialized training in drafting or engineering technology is required. This can usually be obtained in vocational or technical schools or at the college level.

In general, technicians must have a working knowledge of drafting techniques, plan design, and layout procedures. Mathematics courses should include algebra, geometry, and trigonometry as well as mechanical drawing. Technicians must develop skill in the use of drafting instruments and be able to use calculators and scales.

Curricula in junior and community colleges prepare students for technician work and graduates of a 2-year training program can usually apply these credits toward a bachelor's degree. In order to advance above technician-level duties it would probably be necessary to complete requirements for a bachelor's degree in engineering.

Opportunities

With experience, technicians can advance to higher level duties or perhaps supervise subordinate technicians.

Construction and repair of water distribution systems, water purification plants, wastewater treatment facilities, and other pollution control projects should continue strong throughout the eighties. Some technicians will be needed to work with engineers in order to keep up with the increased construction. Some engineering firms hire temporary and part-time engineering technicians to meet production deadlines.

Engineering technicians are employed by Federal, State, and local water pollution control agencies. Others work for consulting engineering firms, architectural firms, municipal treatment plants, and some business and industrial firms concerned with pollution control.

DOT code: Engineering Technician*

Environmental Economist

Economic analyst

Until the early 1970's environmental concerns were generally far removed from the central problems of conventional economics. The role of environmental factors was given only slight consideration in economic theory. Even today, economic textbooks devote very few pages to environmental issues.

Recently, economists have begun to pay more attention to environmental concerns. They want to know how the costs of pollution and environmental deterioration can be evaluated and met by the economic system.[1]

Environmental economists conduct research, prepare reports, and formulate plans to aid in solving economic problems arising from the production and distribution of goods and the negative environmental conditions that are generated as a result of new technologies. They prepare research studies and reports on the possible impact of environmental standards on industry. They predict overall costs and benefits of environmental programs. They help in finding least costly control methods.

Environmental economists work to provide a better understanding of economic principles and how they relate to environmental problems. They show how theories and principles of economic growth, cost-benefit analysis, and the market-pricing mechanism can aid us in protecting our natural resources and improving the quality of life.

It is difficult to put a price tag on environmental quality. Some economists study the market-pricing system in relation to the environment and pollution problems. They assert that the pricing system is applicable in controlling a large part of the pollution problem although, where damage to the environment is severe, they recognize that the pricing system has neither the speed nor the capacity to deal with the problem.[2]

Economists also develop methods of collecting economic and statistical data and compile, organize, and interpret the results. Much statistical data of new technologies compiled in the postwar period, 1945-46, provides useful comparative information for these economists today.

To be an economist, an individual must have a high degree of analytical and organizational ability and an interest in scientific and very technical work.

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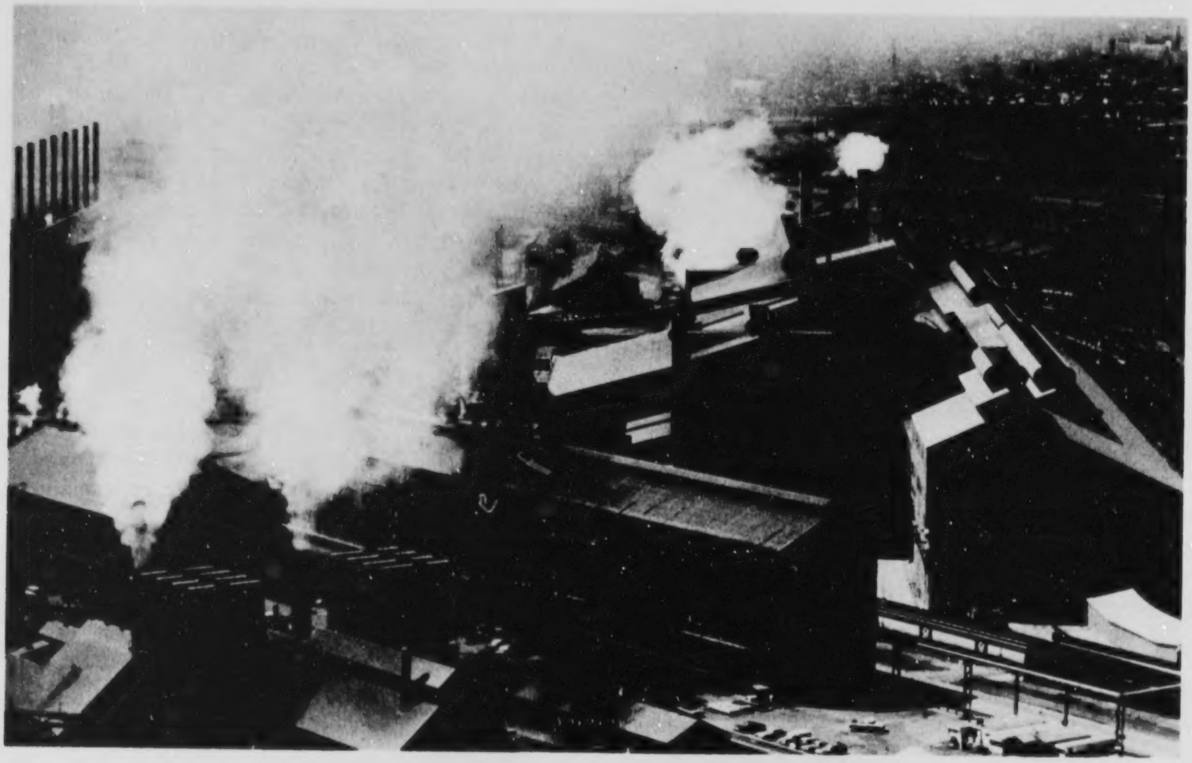
[1] Barry Commoner, *The Closing Circle - Nature, Man, and Technology* (New York: Alfred A. Knopf, 1971), pp. 251-252.

[2] Walter H. Heller, "Coming to Terms with Growth and the Environment," in *Energy, Economic Growth, and the Environment*, ed. Sam H. Schurr (Baltimore: The Johns Hopkins University Press, 1972), p. 28.



Job Requirements

Usually a bachelor's degree with a major in economics is the minimum educational requirement. It is more probable a graduate degree will be required. A Ph.D. is the usual qualification for a faculty position.

Graduate study, with specialization in the economics of the environment, natural resources, health, or transportation, can increase the possibility for employment related to environmental protection.

Opportunities

There are now as many economists in the United States as dentists. The U.S. Department of Labor estimates that there are over 115,000 working economists, or one economist for every four lawyers. Approximately 10 percent of these economists work for the government, another 10 percent teach, and most of the rest are employed in private industry.[3] Increased job opportunities are expected for economists working on environmental problems. However, if this situation should change, a strong background in economics would provide the foundation for any number of specializations.

Environmental economists work as members of environmental teams at all stages of control programs, in deciding on enforcement methods, and in community planning. They also act as consultants to industries, businesses, government and private groups.

DOT code: Economist 050.067-010

Environmental Lawyer

Environmental attorney
Legal counsel, pollution control

Environmental lawyers advise clients on environmental control laws and regulations. They may deal with many environmental issues or specialize, such as in wildlife conservation, noise control, or air resource management.

The environmental lawyer interprets laws and court decisions—often unclear and confusing—and applies them to varied situations. Much of a lawyer's time is spent in library work, reading and summarizing cases to determine precedents. The lawyer also helps write new laws, trying to word them so that they will be clear and easy to enforce.

Legal opinions presented by the environmental lawyer help government agencies solve difficult problems; for example, how to enforce a regulation that customers are not to remove noise-control systems from products.

An agency lawyer is responsible for seeing that staff stays within the law while carrying out duties such as inspecting

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[3] "Report on American Industry," *Forbes*, 8 January 1979, p. 35.

and collecting evidence. Often a lawyer must answer the questions, "Is it legal?" and "Is it enforceable?"

The environmental lawyer may assist an attorney general in preparing and trying lawsuits by selecting evidence, preparing witnesses to testify, and questioning defendents.

Taking a case to court is slow and expenisve. When possible, agreement is reached outside of court. An environmental lawyer negotiates with violators as to how soon and by what means noise violations will be corrected.

The environmental lawyer needs ability in speaking and writing and must be able to deal tactfully with people, including high-level officials of government and industry.

An environmental lawyer working for a citizens' organization may lobby, train others to lobby, or represent the organization in court on public interest cases. A public interest case is one that affects the general public. Examples are lawsuits brought by the Sierra Club and Friends of the Earth to enforce the Clean Air Act.

An environmental lawyer employed in industry keeps management informed of environmental control regulations and how their requirements can be met, defends the firm if it is accused of violations, and may argue in court against a lawyer employed by an environmental control agency.

Job Requirements

After graduation from high school, it takes 7 years of study to become a lawyer.

Usually 4 years of college are required. Coursework includes social sciences, because it is important for a lawyer to understand the human problems that laws are trying to solve. Writing and public speaking are important, too. For environmental law, science courses help in understanding the why and how of environmental control. Courses like engineering, physics, chemistry, and biology should be taken, if possible.

Admission to law school is competitive, and a good scholastic record is necessary. It takes 3 years to finish law school, more if a student decides to attend part time. There are some opportunities for related work experience with environmental control agencies and citizens' organizations that offer internships to law students, either during the summer or the school year.

Environmental lawyers need a year of experience in environmental law and must pass a bar exam.

Opportunities

Environmental lawyers work in government agencies (such as State air control boards and the Noise Enforcement Division of the EPA), citizens' organizations, large industrial firms, law firms, and in private practice.

Environmental lawyers are being hired, but the openings are competitive. There may be more opportunities as the public becomes increasingly aware of the need for a healthful environment.

A lawyer may run for elected office, become a judge, or be promoted to head a legal department.

DOT code: Lawyer 110.107-010

Environmental Lobbyist

Legislative advocate
Washington representative

Environmental lobbyists promote legislation to save natural resources. It is their job to make the environmentalist viewpoint heard above the voices of many others trying to influence legislators. Their concerns include air and water quality, noise abatement, and wildlife protection.

Environmental lobbyists testify at congressional hearings, meet with members of Congress, instruct volunteers in lobbying techniques, and attend meetings of government agencies (such as the Department of Transportation). They meet with reporters and newscasters to encourage news coverage of decisions affecting the environment. They also write articles and speak before groups. They visit organizations — unions, trade associations, and citizen groups — and organize cooperative action to save our resources.

About half the environmental lobbyist's time is spent in persuasion and half in research to keep up to the minute on laws and regulations. He/she must know the differences between various plans and legislation that are proposed. The lobbyist must know how much plans will cost, how they will be financed, and how a bill will affect citizens in each of the key congressional districts. To do all this, the lobbyist needs a memory for details and the ability to win the cooperation of others. Energy and stamina are also necessary.

Job Requirements

The environmental lobbyist needs at least a high school education, and courses in journalism, public relations, mass media communications, or political science are very helpful. Some environmental lobbyists have advanced degrees in law or science.

Knowledge of environmental issues, experience, and the ability to win cooperation are more important than education. Experience in speaking, writing, organizing, lobbying, or campaigning, can be acquired as a paid or as a volunteer worker.

It is estimated that it takes a year or more of on-the-job training to learn the skills of a lobbyist.

Opportunities

Most environmental lobbyists work in Washington, D.C., but some are assigned to State capitals. They may specialize in one problem or promote all environmental issues in which their organization is interested.

Organizations having lobbyists include some of the environmental groups, such as the Sierra Club, other associations of concerned citizens, unions, and political groups. Not all organizations lobby. (Tax-exempt ones cannot). Those that do may be found among national organizations described in the *Conservation Directory*[4] published every year by the National Wildlife Federation.

Some environmental organizations use volunteers and summer interns; this can be an opportunity to get experience and find out what the work is like.

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Promotion is possible to coordinator of legislative activities or to editor of an environmental newsletter or magazine.

DOT code: Lobbyist	165.017-010

Industrial Hygiene Engineer

Frequently industrial hygiene investigation finds that, in order to reduce hazards to workers, changes and modifications must be made to equipment, machines and technical processes. Thus engineers are also employed in the industrial hygiene field.

The industrial hygiene engineer, like the industrial hygienist and industrial hygiene chemist, is concerned with determining the source and nature of hazards to health in industrial environments, and finding the means to their abatement or control. Engineers in this field review engineering drawings, plans, and specifications; conduct site inspections; consult with management and technical personnel; and make recommendations concerning changes in production processes, materials, plant layout, physical working conditions, and use of safeguards.

They also plan and conduct special studies and investigations such as the medical and industrial uses and controls of radiation, the agricultural uses and management of pesticides, and the health implications of new chemicals and production processes. Engineers design, develop, and adapt specialized instrumentation for laboratory or field use, and review plans and specifications for instrumentation.

Like other professionals in the field, industrial hygiene engineers work directly with people much of the time. They meet and confer with industrial designers and engineers, health department officials, physicians, sanitarians, and others to provide assistance on industrial hygiene problems.

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[4] *Conservation Directory* (Washington: National Wildlife Federation. Annual). National Wildlife Federation, 1412 16th St., NW., Washington, D.C. 20036.

An early background in math and science, at the high school level, would be necessary for someone considering an engineering career. In addition to proven math and science aptitudes, high verbal ability would be required. The industrial hygiene engineer may at times be in a defensive position, recommending or requiring costly or unpopular changes in the interests of worker health and safety.

Job Requirements

Acceptance into a job in this field requires graduation from college with major work in engineering, and 1 to 2 years of professional engineering work experience in industrial hygiene, chemical engineering, environmental health, public health, or a closely related engineering field. An engineering master's degree in one of the foregoing curriculums may usually be substituted for 1 year of the required experience. Entry at a junior engineering level may be possible without professional work experience.

The work requires knowledge of basic engineering sciences and techniques used in the preparation of engineering plans, drawings, and specifications; basic principles and practices of public health and industrial hygiene engineering and mechanical industrial processes; and laws, rules, and regulations relating to the health of industrial workers.

Opportunities

Opportunities are expected to increase for industrial hygiene engineers, just as they are for other industrial hygiene specialties. Additional programs and expansion of programs, as well as proliferation of environmental laws requiring enforcement, indicate significant increases in opportunities for this work.

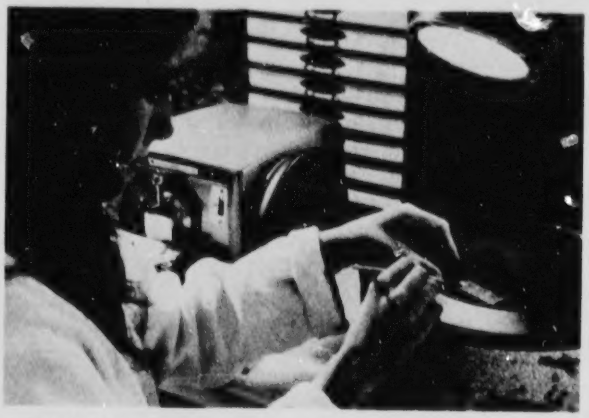
Source of additional information: American Industrial Hygiene Association, 66 South Miller Road, Akron, Ohio 44313.

DOT code: Industrial-Health Engineer 012.167-034

Industrial Hygienist

The National Institute for Occupational Safety and Health (NIOSH) has made a conservative estimate that at least 100,000 deaths take place each year from occupation-related diseases. Considered high-risk among the 5 million worksites in the country are those in the construction, manufacturing, transportation, petrochemicals, dry cleaning, and auto repairs industries. And it is with occupations in those industries that many industrial hygienists are concerned, whether they work in private industry or for government agencies.

The work of industrial hygienists is concerned with making investigations of occupational health conditions in industry and/or government locations, conducting field and laboratory tests, and making recommendations for the prevention, elimination, and control of work-induced illness. Specifically, they make source tests to determine the type and amount of hazardous materials released into the work environment; they review physicians' occupational disease reports and conduct studies among workers in various occupational groups and industries to establish the possibility that causes of disease may be related to work.



Hygienists collect samples of suspected contaminants, make dust counts, collect data from instrument readings, and conduct standardized tests in the course of conducting studies. They also evaluate collected data and make recommendations for the best corrective measures to eliminate or control occupational health hazards or other factors in the work environment which affect employee health. Corrective measures include specifying the maximum allowable concentrations of hazardous materials that may be released into the working environment without endangering the health of workers. When working for government agencies industrial hygienists may also prepare documentation to initiate possible prosecution of violators.

The work requires significant verbal ability and communications skills, as well as numerical aptitude and good analytical ability.

Job Requirements

The educational requirement is a bachelor's degree with major in a physical or biological science. Entry at the full professional level requires several years experience in the practice of industrial hygiene, or a master's degree in public health or industrial hygiene and some work experience in the field. Entry is usually possible at a junior or assistant level with a bachelor's degree and no professional experience.

Industrial hygienists need to know well the principles of industrial hygiene, of environmental health, and the laws and regulations on the health of industrial workers. They also must know the apparatus used to monitor and collect samples for analysis.

Opportunities

The outlook for industrial hygienists should be very good through the mid-1980's as jobs are generated by the establishment of health and safety programs, government requirements, and rising insurance costs. An increased number of opportunities will be found in manufacturing and in the insurance field.

Some employers may prefer to hire a Certified Industrial Hygienist; certification is conferred by the American Board of Industrial Hygiene after the candidate completes the required experience or passes an examination. A graduate degree in industrial hygiene may also be required by some employers.

Technicians who have graduated from a 2-year industrial hygiene program may be able to advance to the professional level, but extensive experience is required to do so.

Source of additional information: American Industrial Hygiene Association, 66 South Miller Road, Akron, Ohio 44313.

DOT code: Industrial Hygienist	079.161-010

Industrial Waste Chemist

Industrial waste chemists are concerned with the treatment, storage, and disposal of industrial waste. This waste can be in air, water, or solid form (such as paper, metal, plastics, sludge, or any other materials that pose a pollution problem). Industrial waste engineers conduct chemical and physical tests on samples to evaluate the presence or quantity of toxic substances, unsuitable conditions in disposal systems, pollutants affecting water tables or rivers, and other conditions related to industrial waste.

These chemists spend much of their time in the laboratory. They calibrate, set up, maintain, and operate a variety of laboratory equipment. They perform many complex tests including chemical and physical analyses of water, sewage, industrial wastes, air, and other substances. They develop laboratory testing routines and decide on the most appropriate procedures, depending upon the problem.

When employed by government regulatory agencies or private industry they conduct on-site investigations of disposal, treatment, and storage facilities. They examine abatement equipment, effluent content, hydrocarbon emissions, temperature conditions, retention time on water and air samples, and many other factors related to handling industrial waste. Their duties are somewhat similar to those of a chemist in a wastewater treatment plant, except they are concerned with a wider range of pollution problems, and they have a somewhat broader scope of duties.

Problem solving is an important part of this occupation. These chemists assist engineers in identifying and solving present or potential pollution problems that involve chemistry. These could mean wastewater treatment, toxic substances, air emissions, storage or disposal of industrial waste, or several problems combined.

The work requires the preparation of clear, scientifically sound, technically accurate, and informative chemical and related reports. Communication skills are also needed to work with managers, professionals, and the public. In many laboratories, the chemist supervises assistants, and possibly an aide.

A good foundation in math is important in high school; science and chemistry courses are also valuable preparation for this work. To be a chemist, a person must have a good academic record, an interest and intellectual curiosity in problems related to chemistry, and a preference for work of a scientific and technical nature.

This is usually light work which requires good finger-hand dexterity and eye-hand coordination. Good eyesight, especially color perception, is important.

Job Requirements

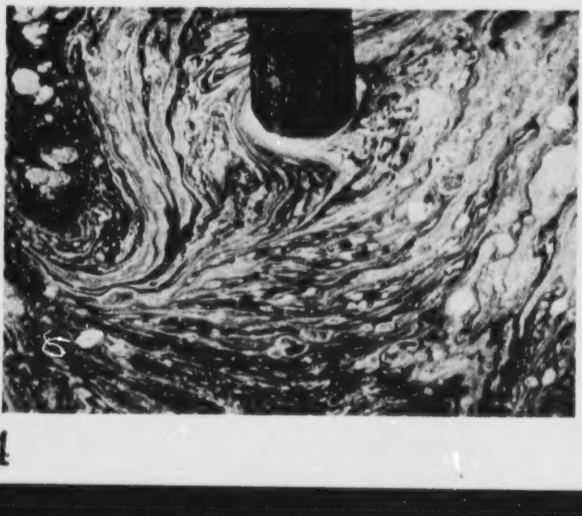
The typical minimum requirement for hire is graduation from college with a specialization in chemistry or chemical engineering.

At least 1 or 2 years of work experience performing chemical analyses of water, sewage, or industrial wastes are also required for entry at the full professional level. Additional education may usually be substituted for the experience requirement (such as an advanced degree in analytical chemistry). Entry is also possible at the junior or assistant level without professional work experience.

A knowledge of the laws and regulations pertinent to pollution control can usually be learned on the job.

Opportunities

There should be a healthy labor market for the next 2 years, particularly for applicants with graduate degrees, partly because of the requirements of the new Federal legislation



concerning hazardous wastes and regulations on disposal practices.

These chemists are primarily employed by government agencies, although an increasing number work for large industrial and consulting firms.

Sources of additional information: American Chemical Society, 1155 - 16th Street N.W., Washington, D.C. 20009; American Institute of Chemical Engineers, 345 East 47th Street, New York, NY 10017.

DOT code: Chemis[illegible]tion Control 022.061-010

Laboratory Aide

Laboratory aides clean laboratory equipment such as glassware, metal instruments, sinks, tables, and test panels using solvents, brushes, and rags.

Aides wash, rinse, and dry the pieces of glassware and instruments used by the laboratory personnel. Aides may also sterilize these objects, using an autoclave.

Aides also keep the laboratory clean. They scrub walls, floors, shelves, tables, and sinks using cleaning fluids and brushes.

In some positions, aides fill tubes and bottles with specified solutions and apply identifying labels, label and file microscope slides, arrange specimens and samples on trays to be placed in incubators and refrigerators, and deliver supplies and laboratory specimens within the plant. Some aides spend all their time cleaning glassware.

Working as an aide requires walking and standing most of the time. Finger and hand dexterity and eye-hand coordination are also important in performing cleaning tasks.

This is elemental work that is routine and repetitious. Because many persons qualify for this work, an applicant's record of reliability and industry are especially important.

Job Requirements

An eighth grade education or less is usually sufficient to perform this work. No previous training or experience is required. These workers generally receive a short demonstration or brief on-the-job training in their duties.

Opportunities

There are a few openings for laboratory aides working in treatment plant laboratories or in laboratories specializing in pollution control work.

Laboratory aides can sometimes transfer to operations or maintenance work in a water or wastewater treatment facility. Or, with additional training and experience, an aide might be able to advance to laboratory technician.

DOT code: Cleaner, Laboratory Equipment 381.687-022

Occupational Health Nurse

Industrial nurse

Occupational health nurses provide nursing services to employees or persons who become ill or suffer an accident in a plant, factory, or business.

These nurses provide emergency nursing care to persons suffering accidents or injuries or becoming ill on the job. In some instances, a physician is not on duty so these nurses must be able to analyze a situation and make a decision quickly about emergency medical care.

Many employers require annual physical examinations for employees as well as examinations for new employees. As part of these screening and testing programs, these nurses give a variety of tests such as audiograms (hearing tests), eye examinations, EKG examinations, blood tests, and X-rays. These results are then reviewed by the physician who decides what is needed.

In some plants, occupational health nurses conduct health and safety meetings and show workers how to protect their health. The ability to speak before groups of people is important in order to explain the programs and motivate workers to be careful and guard their health. In some cases, they may visit work areas and report hazards, such as excessive noise or dust, to the management.

In larger plants, occupational health nurses work with industrial hygienists and industrial-hygiene engineers as well as physicians. They work as a team to prevent accidents, illness, and disease.

A person in this occupation must be exact and precise in order to prepare and administer medicines and treatments. It is also important in maintaining medical records, accident reports, and insurance forms.

This work is performed indoors, in an office. It is light work which can require considerable walking and standing. Good finger and hand dexterity and eye-hand coordination are especially important in order to administer treatments, medicines, and tests. Good eyesight and color perception are also important to recognize and evaluate characteristics in the patient.

Job Requirements

Occupational health nurses are registered nurses. In most cases, they have a bachelor's degree in nursing which usually requires 4 years of college.

In addition, most employers seek individuals with 5 years, or more, experience in nursing. Ideally, someone with considerable emergency room experience or industrial nursing is preferred, especially for those positions where the occupational health nurse is on duty alone at times.

An increasing number of nurses in this occupation are obtaining certification. Certification by the American Board of Occupational Health Nurses requires a minimum of 5 years recent full-time experience in occupational health nursing, 60 course contact hours in educational programs in occupational health or related fields, and a written examination. Course contact hours are hours of participation in an organized continuing education experience. Courses must be a minimum of 5 contact hours to be considered.

Opportunities

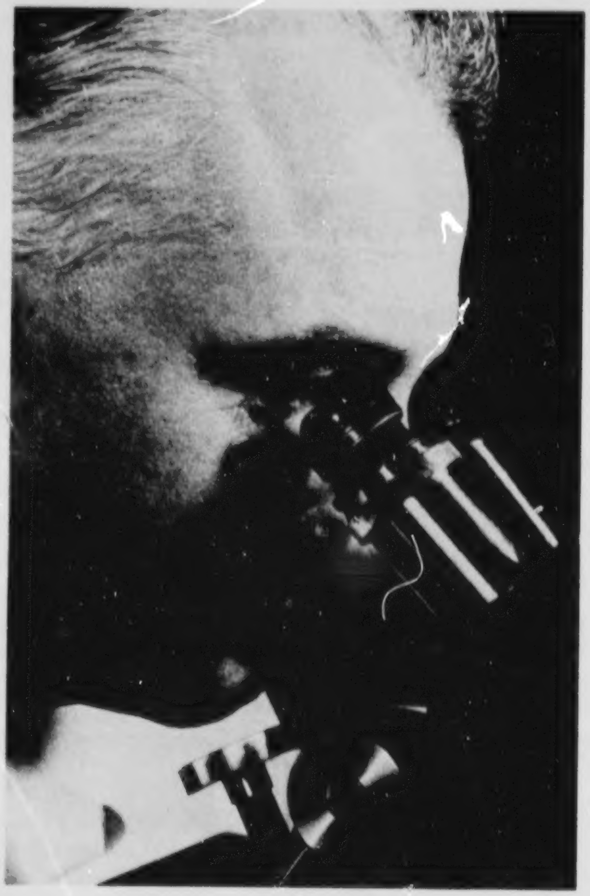
Employers are placing increased emphasis on health services to employees and making the workplace safe.

Because of increasing interest in preventive medicine, more stringent government requirements, and higher insurance rates, employment opportunities should be favorable for qualified occupational health nurses.

Occupational health nurses work in manufacturing, industry, business, transportation, and government.

Source of additional information: American Board for Occupational Health Nurses, Inc., P. O. Box 638, Thousand Palms, Calif. 92276.

DOT code: Nurse, Staff, Occupational Health Nursing 075.374-022



Physician

Medical doctor

No one knows how many workers become ill because of job-related conditions. Unfortunately, occupational diseases often go undetected for years.

Occupational physicians examine workers and diagnose and treat a variety of conditions. They give emergency treatment in accident cases and reexamine workers with disabilities to check on their progress. Usually, an occupational physician refers a worker with a particular problem to a specialist or calls in a specialist to act as a consultant.

In the past, physicians have not had a strong record of detecting and controlling occupational disease. In fact, most outbreaks of occupational disease have been identified accidentally. Exposure to hazardous materials in a workplace often does not have an impact on the incidence of occupational illness for 15 or 20 years. Today, a number of corporations are increasing their medical staffs.

Other physicians participate in hearing conservation and noise control programs. Ear specialists and ear-nose-throat specialists work in hospitals and in private practice but are often asked to act as consultants in hearing conservation and noise control programs.

Not all physicians examine and treat patients. Some plan and administer health programs. The head of a health department in industry is frequently a medical doctor.

Other physicians are engaged in research, applying their medical knowledge to answering questions, for example, about effects of noise and air pollution on the human body.

Job Requirements

Medical training for general practice takes 8 years or more after graduation from high school. For those who want to specialize in one area, such as diseases of the ear, occupational health, or public health, the training may require 10 to 15 years. At present, of the nation's 124 medical schools, very few have training in occupational medicine.

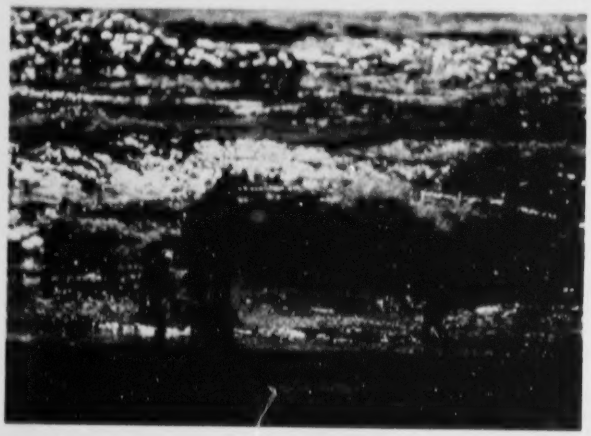
Four years of college are required. The premedical course includes physics, biology, inorganic chemistry, and organic chemistry. Application to medical schools should be made about a year before graduation from college. Entrance is competitive, and a good scholastic record is necessary.

It usually takes 4 years to complete medical school. After graduation, students spend 1 or 2 years as interns and must pass a licensing examination. After internship, the physician may be trained for several years in one speciality of medicine.

Opportunities

There is a continuing demand for physicians. In the future, probably more attention will be given to the occupational diseases.

DOT codes:	Medical Officer	070.101-046
	Otolaryngologist	070.101-062
	Physician, Head	070.101-074
	Physician, Occupational	070.101-078



Federal Job Information Centers

Job Information Centers that provide information regarding jobs in other jurisdictions (city, county, or State) are identified below by a (•).

ALABAMA
Huntsville:
Southerland Building
806 Governors Dr, N.W. 35801
(205) 453-5070

ALASKA
Anchorage:
Federal Bldg.& U.S. Courthouse
701 C St., P.O. Box 22, 99513
(907) 271-5821

ARIZONA
Phoenix:
522 N. Central Ave. 85004
(602) 261-4736

ARKANSAS
Little Rock:
Federal Bldg. Rm. 1319
700 W. Capitol Ave. 72201
(501) 378-5842

CALIFORNIA
Los Angeles:
Linder Bldg.
845 S. Figueroa 90017
(213) 688-3360
Sacramento:
Federal Bldg., 650 Capitol Mall 95814
(916) 440-3441
San Diego:
880 Front St. 92188
(714) 293-6165
San Francisco:
Federal Bldg., Rm. 1001
450 Golden Gate Ave. 94102
(415) 556-667

COLORADO
• Denver:
1845 Sherman St., 80203
(303) 837-3506

CONNECTICUT
Hartford:
Federal Bldg., Rm. 717, 450 Main St.
06103
(203) 244-3096

DELAWARE
• Wilmington:
Federal Bldg., 844 King St. 19801
(302) 571-6288

DISTRICT OF COLUMBIA
Metro Area:
1900 E Street, N.W., 20415
(202) 737-9616

FLORIDA
• Miami:
1000 Brickell Ave., Suite 660, 33131
(305) 350-4725
• Orlando:
80 N. Hughey Ave. 32801
(305) 420-6148

GEORGIA
Atlanta:
Richard B. Russell Federal Bldg.,
75 Spring St. SW, 30303
(404) 221-4315

GUAM
Agana:
238 O'Hara St.
Room 308 96910
344-5242

HAWAII
Honolulu (and Island of Oahu):
Federal Bldg. Room 1310
300 Ala Moana Blvd. 96850
(808) 546-8600

IDAHO
Boise:
Box 035, Federal Bldg.,
550 W. Fort Street 83724
(208) 384-1726

ILLINOIS
Chicago:
Dirksen Bldg. Rm. 1322
219 S. Dearborn St. 60604
(312) 353-5136

INDIANA
Indianapolis:
46 East Ohio Street, Room 123, 46204
(317) 269-7161 or 7162

IOWA
Des Moines:
210 Walnut St., Rm. 191, 50309
(515) 284-4546

KANSAS
Wichita:
One-Twenty Bldg., Rm. 101,
120 S. Market St. 67202
(316) 267-6311, ext. 106
In Johnson and Wyandott Counties dial 374-5702

KENTUCKY
Louisville:
Federal Building
600 Federal Pl. 40202
(502) 582-5130

LOUISIANA
New Orleans:
F. Edward Herbert Bldg.,
610 South St., Rm 103 70130
(504) 589-2764

MAINE
Augusta:
Federal Bldg. Rm. 611
Sewall St. & Western Ave. 04330
(207) 622-6171 ext. 269

MARYLAND
Baltimore:
Garmatz Federal Building
101 W. Lombard St. 21201
(301) 952-3822
DC Metro Area:
1900 E St. N.W., 20415
(202) 737-9616

MASSACHUSETTS
Boston:
3 Center Plaza, 02108
(617) 223-2571

MICHIGAN
Detroit:
477 Michigan Ave, Rm. 595, 48226
(313) 226-6950

MINNESOTA
Twin Cities:
Federal Bldg.
Ft. Snelling, Twin Cities, 55111
(612) 725-3355

MISSISSIPPI
Jackson:
100 W. Capitol St. (Suite 102) 39201
(601) 969-4585

MISSOURI
Kansas City:
Federal Bldg., Rm. 129
601 E. 12th St. 64106
(816) 374-5702
St. Louis:
Federal Bldg., Rm. 1712,
1520 Market St., 63103
(314) 425-4285

MONTANA
Helena:
Federal Bldg. & Courthouse
301 S. Park, Rm. 153 59601
(406) 449-5388

NEBRASKA
Omaha:
U.S. Courthouse and Post Office Bldg.
Rm. 1014, 215 N. 17th St. 68102
(402) 221-3815

NEVADA
• Reno:
Mill & S. Virginia Streets
P.O. Box 3296 89505
(702) 784-5535

NEW HAMPSHIRE
Portsmouth:
Federal Bldg. Rm. 104,
Daniel & Penhallow Streets, 03801
(603) 436-7720 ext. 762

NEW JERSEY
Newark:
Federal Bldg., 970 Broad SXT. ?⅜⅛?¼
(201) 645-3673
In Camden, dial (215) 597-7440

NEW MEXICO
Albuquerque:
Federal Bldg. 421 Gold Ave. SW, 87102
(505) 766-2557

NEW YORK
Bronx:
590 Grand Concourse, 10451
(212) 292-4666
Buffalo:
111 W. Huron St. Rm. 35, 14202
(716) 846-4001
Jamaica:
90-04 161st St., Rm. 200, 11432
(212) 526-6192
New York City:
Federal Bldg., 26 Federal Plaza, 10007
(212) 264-0422
Syracuse:
100 S. Clinton St. 13260
(315) 423-5660

NORTH CAROLINA
Raleigh:
Federal Bldg. 310 New Bern Ave.
P.O. Box 25069, 27611
(919) 755-4361

NORTH DAKOTA
Fargo:
Federal Bldg, Rm. 202
657 Second Ave. N. 58102
(701) 237-5771 ext. 363

OHIO
Cleveland
Federal Bldg., 1240 E. 9th St., 44199
(216) 522-4232
Dayton:
Federal Building Lobby
200 W 2nd St., 45402
(513) 225-2720 and 2854

OKLAHOMA
Oklahoma City:
200 NW Fifth St, 73102
(405) 231-4948

OREGON
Portland:
Federal Bldg., Lobby (North)
1220 SW Third St. 97204
(503) 221-3141

PENNSYLVANIA
• Harrisburg:
Federal Bldg., Rm. 168, 17108
(717) 782-4494
Philadelphia:
Wm. J. Green, Jr. Fed. Bldg,
600 Arch Street, 19106
(215) 597-7440
Pittsburgh:
Fed. Bldg. 1000 Liberty Ave., 15222
(412) 644-2755

PUERTO RICO
San Juan:
Federico Degetau Federal Bldg.
Carlos E. Chardon St.,
Hato Rey, P.R. 00918
(809) 753-4209, ext. 209

RHODE ISLAND
Providence:
Federal & P.O. Bldg., Rm. 310
Kennedy Plaza 02903
(401) 528-4447

SOUTH CAROLINA
Charleston:
Federal Bldg., 334 Meeting St., 29403
(803) 724-4328

SOUTH DAKOTA
Rapid City:
Rm. 201, Federal Building
U.S. Court House, 515 9th St. 57701
(605) 348-2221

TENNESSEE
Memphis:
Federal Bldg., 167 N. Main St. 38103
(901) 521-3956

TEXAS
Dallas:
Rm. 1C42, 1100 Commerce St., 75242
(214) 749-7721
El Paso:
Property Trust Bldg.—Suite N302
2211 E. Missouri Ave. 79903
(915) 543-7425
Houston:
702 Caroline Street, 77002
(713) 226-5501
San Antonio:
643 E. Durango Blvd., 78205
(512) 229-6600

UTAH
Salt Lake City:
350 South Main St. Rm 484, 84101
(801) 524-5744

VERMONT
Burlington:
Federal Bldg., Rm. 614
P.O. Box 489
Elmwood Ave. & Pearl St., 05402
(802) 862-6712

VIRGINIA
Norfolk:

Federal Bldg., Rm. 220,
200 Granby Mall, 23510
(804) 441-3355

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1900 E Street, N.W. 20415
(202) 737-9616

WASHINGTON
• Seattle
Federal Bldg., 915 Second Ave. 98174
(206) 442-4365

WEST VIRGINIA
• Charleston:
Federal Bldg., 500 Quarrier St. 25301
(304) 343-6181, ext. 226

WISCONSIN
Milwaukee:
Plankinton Bldg., Rm. 205,
161 W. Wisconsin Ave. 53203
(414) 244-3761

WYOMING
Cheyenne:
2120 Capitol Ave., Rm. 304
P.O. Box 967 82001
(307) 778-2220, ext. 2108

Glossary

ADULTERANTS: Chemicals or substances that by law do not belong in a food, plant, animal, or pesticide formulation.

AQUEDUCT: A conduit, usually of considerable size, used to carry water.

BACTERIA: Small living organisms which often consume the organic constituents of sewage.

BIOASSAY: The employment of living organisms to determine the biological effect of some substance, factor, or condition.

BIOLOGICAL CONTROL: A method of controlling pests by means of introduced or naturally occurring predatory organisms, sterilization or the use of inhibiting hormones, or other biological means, rather than by mechanical or chemical means.

BOD, or BIOCHEMICAL OXYGEN DEMAND: The dissolved oxygen required by organisms for the aerobic decomposition of organic matter present in water. It is used as a measure of determining the efficiency of a sewage treatment plant or to determine the potential of an effluent to degrade a stream.

CARCINOGENIC: Cancer producing.

COMBINED SEWER: Carries both sewage and storm water runoff.

COMMINUTOR: A device for the catching and shredding of heavy solid matter in the primary stage of waste treatment.

DOSIMETER (DOSEMETER): An instrument used to measure the amount of radiation a person has received.

ECONOMIC POISONS: Those chemicals used to control insects, rodents, plant diseases, weeds, and other pests, and also to defoliate economic crops such as cotton.

EFFLUENT: The liquid that comes out of a wastewater treatment plant after completion of the treatment process.

EPIDEMIOLOGY: The study of diseases as they affect populations.

FILM BADGE: A piece of masked photographic film worn like a badge by nuclear workers to monitor an exposure to radiation. Nuclear radiation darkens the film.

FUNGICIDE: A pesticide chemical that kills fungi or prevents them from causing diseases, usually in plants of economic importance.

GEIGER COUNTER: An electrical device that detects the presence of radioactivity.

GROUNDWATER: The body of water beneath the surface of the ground. It is made up primarily of the water that has seeped down from the surface.

HERBICIDE: A pesticide chemical used to destroy or control the growth of weeds, brush, and other undesirable plants.

INTERCEPTOR SEWERS: In a combined system control the flow of the sewage to the treatment plant. In a storm, they allow some of the sewage to flow directly into a receiving stream. This protects the treatment plant from being overloaded in case of a sudden surge of water into the sewers. Interceptors are also used in separate sanitation systems to collect the flows from main and trunk sewers and carry them to the points of treatment.

IONIZATION CHAMBER: A device roughly similar to a Geiger counter that reveals the presence of ionizing radiation.

IRRIGATION: A land application technique where wastewater is applied to the land to supply the water and nutrient needs of plants.

MONITORING: Periodic or continuous determination of the amount of pollutants or radioactive contamination present in the environment.

PATHOGENIC: Causing or capable of causing disease.

PESTICIDE: An agent used to control pests. This includes insecticides for use against harmful insects; herbicides for weed control; fungicides for control of plant diseases; rodenticides for killing rats, mice, and other rodents; and germicides used in disinfectants, algaecides, slimicides, and other products. Some pesticides can contaminate water, air, or soil and accumulate in man, animals, and the environment, particularly if they are misused. Certain of these chemicals have been shown to interfere with the reproductive processes of predatory birds and possibly other animals.

POLLUTION: Results when animal, vegetable, mineral, or heat wastes or discharges reach water, air, or land, making them less desirable or harmful for users.

PRIMARY TREATMENT: The stage in basic treatment that removes the material that floats or will settle in sewage. It is accomplished by using screens to catch the floating objects and tanks for the heavy matter to settle in.

PUMPING STATIONS: Lift the wastewater to a higher elevation when the continuance of the sewer at reasonable slopes would involve excessive depths of trench; or raise the wastewater from areas too low to drain into available sewers. These stations may be equipped with pneumatic ejectors or centrifugal pumps.

RADIATION: The emission of fast atomic particles or rays by the nucleus of an atom. Some elements are naturally radioactive while others become radioactive after bombardment with neutrons or other particles. The three major forms of radiation are alpha, beta, and gamma.

RECEIVING WATERS: Rivers, lakes, oceans, or other water courses that receive treated or untreated wastewaters.

REFUSE RECLAMATION: The process of converting solid waste to salable products. For example, the composting of organic solid waste yields a salable soil conditioner.

RESOURCE RECOVERY: The process of obtaining materials or energy, particularly from solid waste.

SAND FILTERS: Remove some suspended solids from sewage. Air and bacteria decompose additional wastes filtering through the sand. Cleaner water drains from the bed. The sludge accumulating at the surface must be removed from the bed periodically.

SANITARY LANDFILLING: An engineered method of solid waste disposal on land in a manner that protects the environment; waste is spread in thin layers, compacted to the smallest practical volume, and covered with soil at the end of each working day.

SANITARY SEWERS: In a separate system, pipes in a city that carry only domestic wastewater. The storm water runoff is taken care of by a separate system of pipes.

SECONDARY TREATMENT: The second step in most waste treatment systems in which bacteria consume the organic parts of the wastes. It is accomplished by bringing the sewage and bacteria together in trickling filters or in the activated sludge process.

SEDIMENTATION TANKS: Help remove solids from sewage. The waste-water is pumped to the tanks where the solids settle to the bottom or float on the top as scum. The scum is skimmed off the top, and solids on the bottom are pumped to incineration, digestion, filtration, or other means of final disposal.

SEWAGE: The spent water of a community. The term is often replaced in technical usage by preferable term, wastewater.

SEWERS: A system of pipes that collect and deliver wastewater to treatment plants or receiving streams.

SLUDGE: The solid matter that settles to the bottom, floats, or becomes suspended in the sedimentation tanks and must be disposed of by filtration and incineration or by transport to appropriate disposal sites.

SOLID WASTE DISPOSAL: The ultimate disposition of refuse that cannot be either salvaged or recycled.

SOLID WASTE MANAGEMENT: The purposeful, systematic control of the generation, storage, collection, transport, separation, processing, recycling, recovery, and disposal of solid wastes.

SPECTROPHOTOMETRY: The quantitative measurement with a photometer of the quantity of light of any specific wavelength absorbed by a colored solution or emitted by a sample excited by a flame, arc, or spark.

STORM SEWERS: A separate system of pipes that carry only runoffs from buildings and land during a storm.

SUSPENDED SOLIDS: The small particles of solid pollutants which are present in sewage and which resist separation from the water by conventional means.

TERTIARY TREATMENT: Used in cases where secondary levels of treatment of wastewater are not adequate. In these cases, processes capable of removing pollutants not adequately removed by secondary treament are used in what is called "tertiary wastewater treatment." (These processes are often called advanced wastewater treatment, or AWT for short).

TOXICITY: The quality or degree of being poisonous or harmful to a plant or animal life.

TRICKLING FILTER: A support media for bacterial growth, usually a bed of rocks or stones. The sewage is trickled over the bed so the bacteria can break down the organic wastes. The bacteria collect on the stones through repeated use of the filter.

TURBIDITY: A condition in water caused by the presence of suspended matter; a measure of fine suspended matter in liquid.

VECTOR: Disease vector - a carrier, usually an arthropod, that is capable of transmitting a pathogen from one organism to another.

WASTEWATER: The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In recent years, the word wastewater has taken precedence over the word sewage.

WASTEWATER COLLECTION SYSTEM: The sewer lines, appurtenances, and lift stations used in the collection and conveyance of wastewater.

WASTEWATER TREATMENT PLANT: A series of tanks, screens, filters, and other processes by which pollutants are removed from water.

WATER DISTRIBUTION SYSTEM: The conduits, mains, storage tanks, pumping stations, meters, and supporting equipment used to distribute water to customers.

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156

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Appendix 1

Financial Assistance

The U.S. commitment to higher education is illustrated by the many financial assistance programs that are available to students in this country. The door to greater career opportunity is opening wider than ever before to those groups — women, blacks, Indians, and others — who, in the past, were unable, because of economic and social reasons, to share the advantages of technological improvements made since the turn of the century. In setting career goals, students should keep in mind the many programs designed to help them finance their education.

Millions of students receive financial assistance every year. Any student who is not sure where to find help should consult teachers, guidance counselors, libraries, and university student aid offices. Some programs are designed specifically for minority students; some are for students from low-income families; some are for students interested in certain fields of study, such as engineering.

Often student assistance programs cover only part of the costs of education. However, in such cases students can obtain adequate resources by utilizing combinations of scholarships, loans, part-time jobs, and savings. The young person seeking an education will find that there are many ways to meet the costs.

It is important to start looking for assistance early. Even during their sophomore and junior years in high school, students should gather information about possible sources of financial aid. In order to meet application deadlines, students should inquire about application processes more than a year prior to the academic year for which they are seeking support.

There is very little financial support designed specifically for students in environmental studies. However, the federal programs described below support students in a broad range of academic fields, including fields related to environmental studies.

In studying student assistance programs, students should keep in mind the distinction among grants, loans, and employment. Grants are gifts of money; they do not have to be repaid. Loans are borrowed money which must be repaid with interest. Employment allows students to work and earn the money they need.

The U.S. Office of Education reminds students that postsecondary education is one of the largest investments they will make. As consumers, students should carefully evaluate what they are purchasing. Before making final decisions on education and training, students should have information about schools' academic programs, facilities, drop-out rates, full costs of attendance, refund policies, financial aid policies, and other information they feel they need.

Students should be careful to avoid wasting time in the process of applying for financial assistance. They can do so by evaluating their own needs and assessing the likelihood that particular student assistance programs will meet those needs. They should ask themselves several questions. How many students have received assistance from a particular program in the past, and what was the average amount awarded? Does the program concentrate on providing support to certain groups, such as women and minorities? Is it designed for graduate or undergraduate students? Does it emphasize supporting students from low income families? Does it support only students who plan to study in certain academic fields, such as engineering?

For example, students reviewing the Basic Educational Opportunity Grant (BEOG) Program should observe that the program supported almost 2½ million students during the academic year 1978-79, in amounts ranging from $50 to $1,600. (In the award period July 1, 1979 to June 30, 1980, grants were to range to $1,800.) The program does not emphasize supporting certain groups such as women and minorities. Amount of award is based on students' financial need. Students do not have to be enrolled in specified academic fields of study to be eligible.

Students considering applying for the Supplemental Educational Opportunity Grant (SEOG) Program, under which students receive support not only from the Federal Government but also from their schools, should observe that (1) the Supplemental Program is for "students of exceptional financial need who, without the grant, would be unable to continue their education," and (2) the program was expected to support far fewer students (465,900) in the academic year 1978-79 than was the Basic Educational Opportunity Grant Program. Also, students evaluating the program would need to find out what is meant by "exceptional financial need."

Besides Federal programs, there are scholarship programs maintained at individual universities, as well as programs operated by businesses and private foundations. At the end of this appendix is a list of other sources of information on student assistance.

U.S. Office of Education (USOE)

The U.S. Office of Education offers the following student financial aid programs:

1. The Basic Educational Opportunity Grant (BEOG) Program
2. The Supplemental Educational Opportunity Grant (SEOG) Program
3. The College Work-Study (CWS) Program
4. The National Direct Student Loan (NDSL) Program
5. The Guaranteed Student Loan (GSL) Program
6. The Health Education Assistance Loan (HEAL) Program

To be eligible for aid under any of these programs, students must be enrolled at least halftime in eligible programs at postsecondary colleges, universities, vocational schools, technical schools, or hospital schools of nursing participating in USOE financial aid programs.

There are about 9,000 institutions participating in USOE programs. Although the U.S. Office of Education determines the eligibility of a school for participation in USOE financial aid programs, the government does not make judgments about or endorse the quality or suitability of the education offered by the schools. It is the students' responsibility to evaluate carefully the content and quality of the schools and their curricula.

To be eligible for any of these six programs, students must meet one of the following citizenship requirements: (1) Be a citizen, national, or permanent resident of the United States, the Northern Mariana Islands, or the Trust Territory of the Pacific Islands; (2) be in the United States for other than a temporary purpose and be able to provide documentation of intent to become a permanent resident.

With the exception of the Guaranteed Student Loan Program and the Health Education Assistance Loan Program, the amount of student assistance awarded under these six programs is based on the ability of students and their families to pay educational expenses. Estimates of ability to pay vary depending on which system of determining ability to pay is used at a particular school.

Undergraduates may apply for any of the USOE programs. Graduate students may apply only for National Direct Student Loans, Guaranteed Student Loans, College Work Study, and Health Education Assistance Loans.

1. The BASIC EDUCATIONAL OPPORTUNITY GRANT PROGRAM (BEOG) provides funds to undergraduate students who have been accepted for enrollment in, or are in good standing at, eligible institutions of higher education.

Unlike other USOE financial aid programs, all eligible students will receive Basic Grant awards. Students are eligible for up to 4 years of undergraduate study (or 5 years in some cases). During the 1979-80 academic year, it was expected that an estimated 2,700,000 students would receive Basic Grants ranging from $200 to $1,800, depending on students' eligibility and financial need as determined by a standard formula.

Although most students are paid their Basic Grants through their schools, their eligibility and actual amounts of awards are determined by the Office of Education. Financial aid officers at schools cannot make adjustments to students' Basic Grants beyond those required by the Government.

For information on submitting applications and determining eligibility, students should contact financial aid offices at eligible institutions of higher education or write to the following address: Bureau of Student Financial Assistance, P.O. Box 84, Washington, D.C. 20044.

2. The SUPPLEMENTAL EDUCATIONAL OPPORTUNITY GRANT PROGRAM (SEOG) is designed for students of exceptional financial need who, without the grant, would be unable to continue their education. Graduate students are not eligible.

Students must be accepted for admission or be enrolled at an eligible institution on at least a halftime basis, and must be in good academic standing. During the academic year 1979-80, grants were to range from $200 to $1,500 per academic year, with a limit of $4,000 for 4 years or $5,000 for 5 years. In the award period 1978-79, it was estimated that the program would enable 573,000 students to pursue their education at 3,725 participating institutions.

Students who are interested should contact the financial aid officers at the institutions they want to attend. These institutions, which are responsible for determining who will receive Supplemental Grants and the amounts, are required to provide additional financial assistance at least equal to the amounts of the Supplemental Grants.

3. The COLLEGE WORK-STUDY PROGRAM (CWS) provides jobs for graduate, undergraduate, and vocational students who have great financial need and who must earn a part of their educational expenses. Applicants must be enrolled at least halftime in approved postsecondary educational institutions. In the award period 1978-79, it was estimated that approximately 3,200 institutions would employ 990,000 students.

Education institutions participating in College Work-Study arrange jobs on campus or off campus with public and private nonprofit agencies, such as hospitals. Eligible students may be employed for as many as 40 hours a week. In arranging jobs and determining how many hours a week students may work under this program, financial aid officers take into account students' (1) need for financial assistance; (2) class schedules; and (3) health and academic progress. In general, salaries are at least equal to the current minimum wage. Maximum hourly wage rates depend on the jobs and on students' qualifications.

Students should apply through their schools' financial aid officers, who are responsible for determining applicants' eligibility and arranging jobs.

4. The NATIONAL DIRECT STUDENT LOAN PROGRAM (NDSL) is for students who are enrolled at least halftime in participating postsecondary institutions and who need loans to meet their educational expenses. During the loan period 1978-79, it was estimated that 3,500 institutions would lend $649,268,000 to 910,000 students.

As of the academic year 1979-80, students were permitted to borrow up to a total of: (a) $2,500 if they were enrolled in vocational programs or if they had completed less that 2 years of programs leading to bachelor's degrees; (b) $5,000 if they were undergraduates who had already completed 2 years of study toward bachelor's degrees (this total included amounts borrowed under NDSL for the first 2 years of study); (c) $10,000 for graduate study (this included any amounts borrowed under NDSL for undergraduate study).

Under this program, repayment begins 9 months after students graduate or leave school for other reasons. The amount of the repayment depends on the size of the debt and the ability to pay, but in most cases students must pay at least $360 a year unless the school agrees to a lesser amount. Borrowers may be allowed up to 10 years to pay back loans. During the repayment period 3 percent interest is charged on unpaid balances of principal. No payments are required for up to 3 years while students serve in the Armed Forces, Peace Corps, or VISTA. In addition, deferment is available any time students return to at least halftime study at an eligible institution.

Applications may be made through schools' financial aid officers. They can also provide information about loan cancellation provisions for borrowers who go into certain fields of teaching or specified military duty.

5. The GUARANTEED STUDENT LOAN PROGRAM (GSL) enables students to borrow directly from banks, credit unions, savings and loan associations, and other participating lenders who are willing to make the education loans. Loans are guaranteed by State or private nonprofit agencies or are insured by the Federal Government.

Students may apply for loans if they are enrolled or have been accepted for enrollment at least halftime in participating postsecondary institutions. It was estimated that 1,143,000 loans would be made under this program during fiscal year 1980.

As of the academic year 1979-80, the maximum per year that undergraduates could borrow was $2,500. Graduate or professional students could borrow up to $5,000 per year (in some States, less). Interest could not be more than 7 percent. The total that could be borrowed for undergraduate or vocational study was $7,500. The total was $15,000 for graduate or professional study, including loans made at the undergraduate level.

All students are eligible for Federal interest benefits, regardless of family income. The Federal Government will pay the interest until students must begin repaying loans, and during authorized period of deferment.

Repayments of loans normally begin between 9 and 12 months after students graduate or leave school; students may be allowed to take up to 10 years to repay loans. The amount of the payment depends upon the size of the debt and the ability to pay; but in most cases students pay at least $360 a year unless circumstances agreed upon by the lending institution warrant a lesser amount.

Students do not have to make payments for up to 3 years while serving in the Armed Forces, Peace Corps, or full-time volunteer programs conducted by ACTION (which includes VISTA, University Year for ACTION, ACTION cooperative Volunteer Programs, Volunteers in Justice, and the Program for Local Service). In addition, deferment is available any time students return to full-time study at eligible institutions or pursue courses of study under graduate fellowship programs. Single deferments up to one year are also provided for students who are unable to find full-time employment.

Information and application forms are available from financial aid officers at schools, as well as from lenders, State Guarantee Agencies, and Regional Offices of the U.S. Office of Education.

6. The HEALTH EDUCATION ASSISTANCE LOAN PROGRAM (HEAL) provides federally insured loans to graduate students attending eligible schools of medicine, osteopathic medicine, dentistry, veterinary medicine, optometry, podiatry, pharmacy, and public health. The loans are made by participating lenders, including banks, credit unions, savings and loan associations, and educational institutions.

As of the academic year 1979-80, the maximum students could borrow was $10,000 per academic year to a total of $50,000. Pharmacy students were limited to $7,500 per academic year to a total of $37,500.

There is no Federal interest subsidy for these loans. Interest may not exceed 12 percent per year (annual percentage rate) on the unpaid balance of the loan. In addition to the interest, there is an insurance premium of one-quarter of 1 percent per year that is charged in advance.

Repayment begins 9 months after completion of formal training — including accredited internship and residency programs — or withdrawal from school. Borrowers have 10 to 15 years to repay the loan.

Repayment of principal can be deferred (a) for full-time study at a Health Education Assistance Loan school or an institution of higher education that is participating in the Guaranteed Student Loan Program; (b) for up to 3 years for internship or residency training, service in the Armed Forces, Peace Corps, ACTION, or the National Health Service Corps.

At the option of the Federal Government, a borrower may apply for Federal payments for service in the Natonal Health Service Corps or private practice in a health manpower shortage area.

To apply for a Health Education Assistance Loan, the borrower must obtain an application from the financial aid officer at a health professions school. After completing the borrower's section, the borrower must have the school section completed by the financial aid officer and submit the application to a participating lender. For further information, students should contact HEAL, Post Office Box 23033, L'Enfant Plaza, Washington, D.C. 20024.

National Science Foundation

The National Science Foundation provides fellowships to highly skilled graduate students in the sciences, engineering, and mathematics. Students pursue training at institutions of their own choice. Fellowships provide for stipends and cost-of-education allowances, which are paid to the applicant through his or her institution. Recipients must remain full-time students for the duration of the grants. In the fiscal year 1978, 1,450 awards were anticipated. Applications for fellowships should be made during the fall prior to the academic year for which assistance is requested.

Under other project grants awarded by the Foundation, funds may be used for paying costs necessary to conduct research or studies, such as salaries and expendable equipment and supplies, travel, publications, participant costs, other direct costs, and indirect costs.

The Foundation also has programs (1) to encourage training for research and teaching at all levels, and (2) to provide research experience to a number of talented high school and college students showing early promise in science. During the summer of 1978 over 1,200 undergraduates participated in the Undergraduate Research Participation Program; over 500 undergraduates conducted independent research in the Student-Originated Studies Program. During the summer of 1978, programs for high-ability high school students provided about 5,450 opportunities for scientific training.

For additional information about National Science Foundation Programs, write to the Public Information Branch, National Science Foundation, Washington, D.C. 20550.

U.S. Department of Energy

The U.S. Department of Energy has several programs of interest to students and faculty. Under the UNIVERSITY-LABORATORY COOPERATIVE PROGRAM, the Department provides special energy-related training and work experience to university students and faculty in science and engineering fields. The training and work experience are provided at participating laboratories. The Department of Energy also has a program, FACULTY TRAINING INSTITUTES, SHORT COURSES, AND WORKSHOPS ON ENERGY AND ENVIRONMENTAL SUBJECTS, under which energy- and environment-related update training is provided to university science and engineering faculty and to high school science and social science teachers. The PREFACE (PREFRESHMAN AND COOPERATIVE EDUCATION FOR MINORITIES IN ENGINEERING) PROGRAM promotes equitable participation of all Americans in energy-related careers; specifically, the program is designed to increase the education opportunities available to qualified and qualifiable minority group members and women in energy-related fields of engineering. Using enrichment programs, such as summer programs and academic year weekend programs, PREFACE prepares prefreshman for engineering studies at universities.

For information on universities and laboratories participating in programs of the U.S. Department of Energy, students should write to the Educational Programs Division, U.S. Department of Energy, Mail Stop 8G-031, Forrestal Building, Washington, D.C. 20585.

Other Sources of Information

Other Sources of Information About Student Financial Assistance:

American Legion
Emblem Sales
P.O. Box 1055
Indianapolis, Indiana 46206
Request: *Need A Lift?* Single copies, $1.00; orders of 100 or more, $0.75 each.

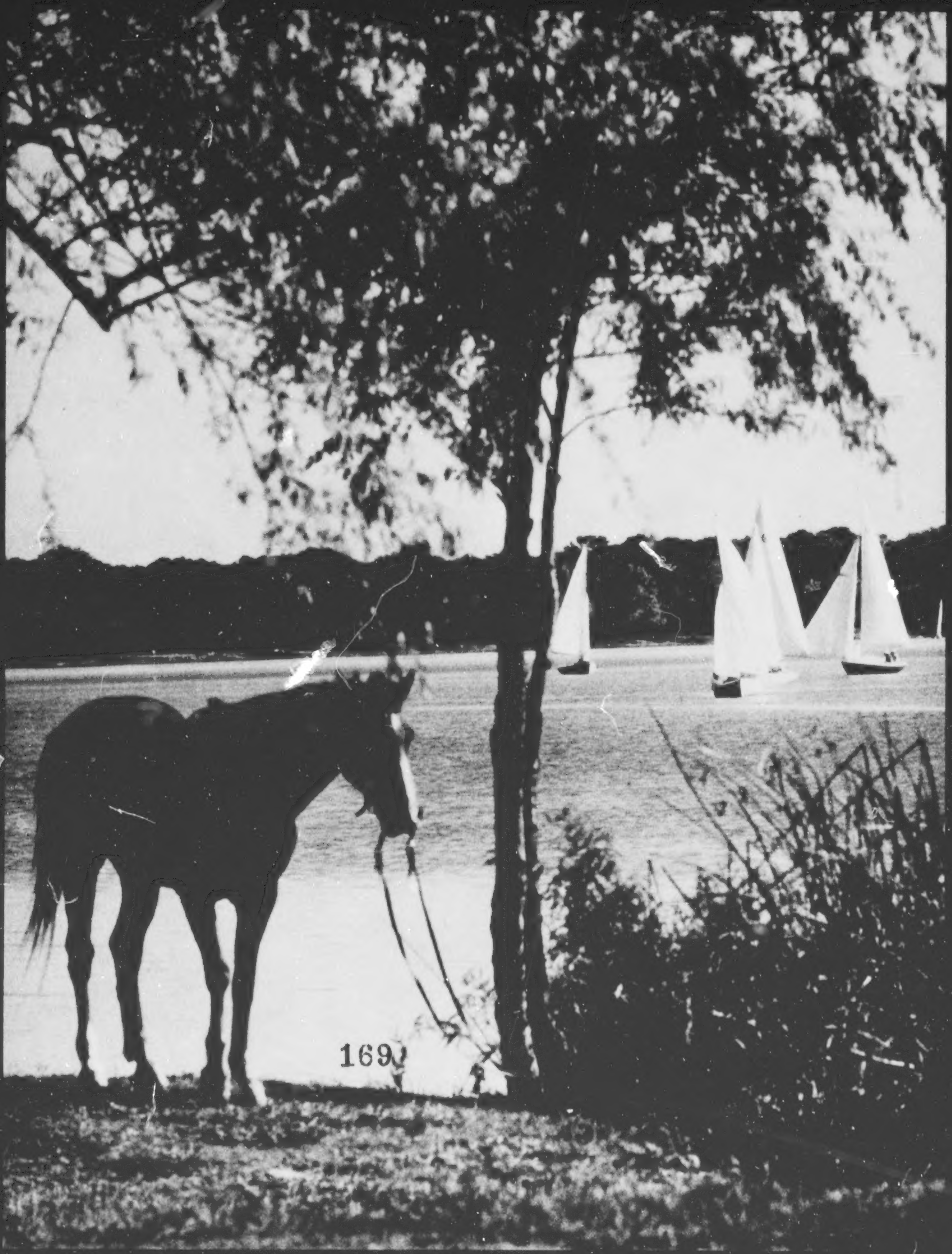
National Science Foundation
Publications Branch
1800 G Street, N.W.
Washington, D.C. 20550
Request: *A Selected List of Major Fellowship Opportunities and Aids to Advanced Education for United States Citizens.* Free
A List of Major Fellowship Opportunities and Aids to Advanced Education for Foreign Nationals. Free

American College Testing Program
P.O. Box 808
Iowa City, Iowa 52243
Request: *College Planning/Search Book.* $6.00

National Commission for Cooperative Education
360 Huntington Avenue, Boston, Massachusetts 02115
Request: List of colleges and universities offering programs of cooperative education. Free

Basic Grants
P.O. Box 84
Washington, D.C. 20044
Request: Information on student financial assistance programs of the U.S. Office of Education. Free

Appendix 2



Postsecondary Environmental Education Programs, by Type of Pollution, by State

The following list of postsecondary environmental education programs was extracted from a 12-volume study[1] published in 1979 under a grant from the Environmental Protection Agency.

The list, which shows programs by State, is divided into the same sections as was the original study, beginning with academic programs concerned with wastewater pollution:

1. Wastewater Programs
2. Drinking Water Programs (Potable Water Programs)
3. Air Programs
4. Noise Programs
5. Pesticides and Toxicology Programs
6. Solid Waste Programs
7. Radiation Programs
8. Energy Programs
9. Combined Drinking Water/Wastewater Programs
10. Environmental Science/Health Programs
11. Environmental Engineering/Technology Programs
12. Environmental Studies Program

Some educational programs do not readily fall into any pollution control category such as air or noise; some programs could be classified in several areas. The last three items on the list — Environmental Science/Health, Environmental Engineering/Technology, and Environmental Studies — are presented to accomodate those programs that do not seem to fit under one of the preceding nine categories.

We recommend that students use the list as a starting point in evaluating programs rather than as a document from which to make final decisions concerning choice of school. Postsecondary programs change periodically; therefore, some entries may go out of date from time to time. (Some programs are offered every other year rather than every year.)

The list does not rate the programs or describe individual courses that students take, nor does a program's being represented in this list assure that graduates of that program meet specialized occupational requirements. In order to be sure that an educational program will qualify him or her for a specific occupation, the student should consult prospective employers, school counselors, family, friends, persons already working in the occupation, professional and trade associations, State Employment Services, libraries, and others. In general, the more information students have about tuition, course offerings, degree requirements, and faculty, and the more information they have about the occupations for which they are studying, the better prepared they are to make decisions concerning what schools to attend.

The list includes entries from junior colleges, vocational and technical training institutes, community colleges, 4-year colleges and universities, and others. Programs are representative of all levels, from academic certification through doctoral degrees. At the end of each entry in the list, the degree level (certificate, 4-year, graduate, for example) is shown in parentheses.

For additional copies, write: Jeff Meetre (RD-680), National Workforce Development Staff, U.S. Environmental Protection Agency, Washington, D.C. 20460

1. Wastewater Programs

California
Palomar College
Vocational Education Department
1140 West Mission Road
San Marcos, California 92069
(Certificate; 2-year)

Connecticut
University of Connecticut
Civil Engineering Department
Storrs, Connecticut 06268
(Graduate)

District of Columbia
University of the District of Columbia
Environmental Science Department
4200 Connecticut Avenue N.W.,
Washington, D.C. 20008
(2-year)

Florida
Miami-Dade Community College
Engineering Department
11011 S.W. 104th Street
Miami, Florida 33176
(Certificate)

North Florida Junior College
Wastewater Treatment Department
Madison, Florida 32340
(Certificate)

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[1] *Directory of Post-Secondary Environmental Education, National Environmental/Energy Workforce Assessment, Phase III.* (Iowa City: National Field Research Center, Inc., May 1979. 230 East Benton, P.O. Box 287, Iowa City, Iowa 52240.)

University of Florida
Environmental Engineering Sciences
Department
Gainesville, Florida 32611
(Graduate)

Illinois

Carl Sandburg College
Vocational/Technical Education Department
Box 104
South Lake Storey Road
Galesburg, Illinois 61401
(1-year, 2-year)

Maine

Southern Maine Vocational and Technical
Institute
Wastewater Treatment Technology Department
2 Fort Road
South Portland, Maine 04106
(Certificate)

University of Maine
Civil Engineering Department
103 Boardman Hall
Orono, Maine 04473
(Graduate)

Maryland

Charles County Community College
Pollution Abatement Technology Department
La Plata, Maryland 20646
(2-year)

Garrett Community College
Division of Mathematics
Science and Environmental Studies
McHenry, Maryland 21541
(Certificate)

Massachusetts

North Shore Community College
Essex Agricultural and Technical Institute
3 Essex Street
Beverly, Massachusets 01915
(2-year)

University of Lowell
Wastewater Treatment Department
Civil Engineering Technology
Lowell, Massachusetts 01854
(Certificate)

Nebraska

University of Nebraska
Civil Engineering Department
Lincoln, Nebraska 08508
(4-year; Graduate)

New York

State University of New York at Buffalo
Civil Engineering Department
Parker Engineering
Buffalo, New York 14214
(4-year; Graduate)

Ulster County Community College
Science Laboratory Technology Department
Stone Ridge, New York 12142
(2-year)

North Carolina

Southeastern Community College
Adult Education Department
P.O. Box 151
Whiteville, North Carolina 28472
(No degree)

University of North Carolina at Chapel Hill
Environmental Sciences and Engineering
School of Public Health
Chapel Hill, North Carolina 27514
(Graduate)

Western Piedmont Community College
Natural Science and Mathematics Department
Morgantown, North Carolina 28655
(Certificate)

Oklahoma

Oscar Rose Junior College
Environmental Science Department
6420 S.E. 15th Street
Midwest City, Oklahoma 73110
(2-year)

Oregon

Clackamas Community College
Water Quality Curriculums Department
19600 South Molalla Avenue
Oregon City, Oregon 97045
(2-year)

Linn-Benton Community College
Science & Technology Division
6500 S.W. Pacific Blvd.
Albany, Oregon 97321
(2-year)

Tennessee

State Technical Institute at Memphis
Environmental Engineering Technology
Department
5983 Macon Cove, Memphis
Tennessee 38134
(2-year)

Virginia

Central Virginia Community College
Engineering and Technology Division
Wards Road South
P.O. Box 4098
Lynchburg, Virginia 24502
(2-year)

Northern Virginia Community College
Environmental and Natural Sciences Division
Woodbridge Campus
15200 Smoketown Road
Woodbridge, Virginia 22191
(Certificate)

West Virginia

West Virginia University
Engineering Department
Morgantown, West Virginia 26506
(Graduate)

2. Drinking Water Programs (Potable Water Programs)

Alabama

University of Alabama
Civil Engineering Department
University, Alabama 35486
(Graduate)

California

California Institute of Technology
Engineering and Applied Science Department
1201 East California Blvd.
Pasadena, California 91125
(4-year; Graduate)

California State University at Fullerton
Earth Science Department
Fullerton, California 92634
(4-year)

California State University at Long Beach
Civil Engineering Department
1250 Bellflower Blvd.
Long Beach, California 90840
(4-year; Graduate)

California State University at Los Angeles
Civil Engineering Department
5151 State University Drive
Los Angeles, California 90032 (4-year;
Graduate)

Imperial Valley College
Water Treatment Technology Department
P.O. Box 158
Imperial, California 92251
(Certificate: 1-year; 2-year)

Palomar College
Vocational Education Department
1140 West Mission Road
San Marcos, California 92069
(Certificate; 2-year)

San Jose State University
Civil Engineering & Applied Mechanics
Department
125 South Seventh Street
San Jose, California 95192
(4-year; Graduate)

Stanford University
Civil Engineering Department
Palo Alto, California 94305
(4-year; Graduate)

University of California at Berkeley
Civil Engineering Department
Berkeley, California 94720
(Graduate)

University of California at Davis
Civil Engineering Department
Davis, California 95616
(4-year)

University of California at Davis
Land, Air, and Water Resources Department
Davis, California 95616
(Graduate)

University of Southern California
Civil Engineering Department
Los Angeles, California 90007
(4-year; Graduate)

Florida

Florida International University
Division of Environmental Technology and
Urban Systems
Tamiami Trail, Miami, Florida 33199
(4-year; Graduate)

Miami-Dade Community College
Engineering Department
South Campus
11011 S.W. 104th Street
Miami, Florida 33176
(Certificate)

University of Florida
Environmental Engineering Sciences
Department
Gainesville, Florida 32611
(Graduate)

University of Florida
Agricultural Engineering Department
College of Engineering
Gainesville, Florida 32611
(4-year; Graduate)

Georgia
University of Georgia
School of Forest Resources
Athens, Georgia 30602
(4-year; Graduate)

Indiana
Ball State University
Department of Natural Resources
Room 110
West Quadrangle
Muncie, Indiana 47306
(4-year)

Purdue University
Purdue University Natural Resources Research Institute
West Lafayette, Indiana 47907
(Graduate)

Kentucky
University of Kentucky
Agricultural Engineering Department
Lexington, Kentucky 40506
(4-year; Graduate)

University of Kentucky
Chemical Engineering Department
Lexington, Kentucky 40506
(4-year; Graduate)

University of Kentucky
Civil Engineering Department
Lexington, Kentucky 40506
(4-year; Graduate)

Michigan
Northern Michigan University
Interdisciplinary Department
279 West Science Street
Marquette, Michigan 49855
(4-year)

University of Michigan
Environmental & Industrial Health Department
School of Public Health
Ann Arbor, Michigan 48104
(Graduate)

Minnesota
University of Minnesota
Civil & Mineral Engineering Department
Institute of Technology
112 Mineral & Metallurgical Engineering Building
Minneapolis, Minnesota 55455
(4-year; Graduate)

Nebraska
University of Nebraska
Civil Engineering Department
Lincoln, Nebraska 08508
(Graduate)

University of Nebraska
Interdepartmental Program in Water Resources Planning and Management
Lincoln, Nebraska 08508
(Graduate)

New Hampshire
University of New Hampshire
Institute of Natural & Environmental Resources
Durham, New Hampshire 03824
(Graduate)

New York
State University of New York at Stony Brook
Marine Environmental Sciences
Coastal Oceanography
Marine Sciences Research Center
Stony Brook, New York 11794
(Graduate)

Oregon
Chemeketa Community College
Trade and Industry Department
P.O. Box 1007
Salem, Oregon 97308
(2-year)

Clackamas Community College
Water Quality Curriculums Department
19600 South Molalla Avenue
Oregon City, Oregon 97045
(2-year)

Pennsylvania
Allegheny College
Aquatic Environments Department
Meadville, Pennsylvania 16335
(4-year)

South Carolina
University of South Carolina
Geology Department
Columbia, South Carolina 29208
(4-year; Graduate)

Tennessee
University of Tennessee
Water Resources Research Center
Knoxville, Tennessee 37916
(Graduate)

Texas
University of Texas at Austin
Civil Engineering Department
Austin, Texas 78712
(4-year; Graduate)

Virginia
J. Sargeant Reynolds Community College
Ground Water Resources Program
P.O. Box 12084
Richmond, Virginia 23241
(Certificate)

Wisconsin
University of Wisconsin at Madison
Water Resources Management Executive Committee
Madison, Wisconsin 53706
(Graduate)

University of Wisconsin at Stevens Point
College of Natural Resources
Stevens Point, Wisconsin 54481
(4-year; Graduate)

Wyoming
University of Wyoming
Civil and Architectural Engineering Department
P.O. Box 3334
University Station
Laramie, Wyoming 82071
(4-year; Graduate)

3. Air Programs

California
University of California at Berkeley
Civil Engineering Department
Berkeley, California 94720
(4-year; Graduate)

Colorado
Colorado State University
Atmospheric Chemistry Program
Interdisciplinary Department
Fort Collins, Colorado 80523
(Graduate)

Connecticut
Yale University
Department of Forestry & Environmental Studies
New Haven, Connecticut 06520
(Graduate)

District of Columbia
University of the District of Columbia
Environmental Science Department
4200 Connecticut Avenue, N.W.
Washington, D.C. 20008
(Certificate; 2-year)

Florida
University of Florida
Environmental Engineering Sciences Department
Gainesville, Florida 32611
(Graduate)

Illinois
Illinois Institute of Technology
Pritzker Department of Environmental Engineering
102 Alumni Memorial Hall
Chicago, Illinois 60616
(Graduate)

University of Illinois at Urbana-Champaign
Civil Engineering Department or Mechanical and Industrial Engineering Department
Urbana, Illinois 61801
(4-year; Graduate)

Indiana
Ball State University
Natural Resources Department
Room 110
West Quadrangle
Muncie, Indiana 47306
(4-year)

Kentucky
University of Kentucky
Chemical Engineering Department
Lexington, Kentucky 40506
(4-year; Graduate)

Massachusetts
Worchester Polytechnic Institute
Chemical Engineering Department
Worcester, Massachusetts 01609
(4-year)

Michigan
University of Michigan
Environmental & Industrial Health Department
School of Public Health
Ann Arbor, Michigan 48104
(Graduate)

Missouri
Washington University
Mechanical Engineering Department
Box 1185
Lindell & Skinker Blvds.
St. Louis, Missouri 63130
(Graduate)

New Jersey
Stevens Institute of Technology
Mechanical Engineering Department
Castle Point Station
Hoboken, New Jersey 07030
(Certificate of Special Studies awarded)

New York
City University of New York
City College School of Engineering
Civil Engineering
Convent Ave. at 138th St.
New York, New York 10031
(Graduate)

State University of New York at Albany
Atmospheric Science Department
1400 Washington Avenue
Albany, New York 12222
(Graduate)

Syracuse University
Chemical Engineering & Materials Science Department
Syracuse, New York 13210
(4-year; Graduate)

North Carolina
Duke University
Forestry and Environmental Studies Department
Durham, North Carolina 27706
(Graduate)

North Carolina State University
Department of Chemical Engineering
Raleigh, North Carolina 27607
(Graduate)

University of North Carolina at Chapel Hill
Environmental Sciences and Engineering School of Public Health
Chapel Hill, North Carolina 27514
(Graduate)

Ohio
Muskingum Area Technical College
Division of Engineering & Science
1555 Newark Road
Zanesville, Ohio 43701
(2-year)

Ohio State University
Chemical Engineering Department
140 West 19th Street
Columbus, Ohio 43210
(4-year; Graduate)

University of Cincinnati
Environmental Health Department
Kettering Laboratory
Room 107
Cincinnati, Ohio 45267
(Graduate)

Oregon
Oregon Graduate Center
Department of Environmental Technology
19600 N.W. Walker Road
Beaverton, Oregon 97005
(Graduate)

Portland State University
Engineering and Applied Science Department
P.O. Box 751
Portland, Oregon 97207
(Graduate)

Pennsylvania
Pennsylvania State University
Air Pollution Contol Engineering Technology Department
University Park, Pennsylvania 16802
(2-year)

University of Pittsburgh
Industrial Environmental Health Sciences Department
Graduate School of Public Health
University of Pittsburgh
Pittsburgh, Pennsylvania 15620
(Graduate)

South Carolina
Clemson University
Environmental Systems Engineering Department
Clemson, South Carolina 29631
(Graduate)

Tennessee
University of Tennessee
Civil Engineering Department
Knoxville, Tennessee 37916
(4-year; Graduate)

Vanderbilt University
Environmental Engineering and Policy Management Department
Nashville, Tennessee 37240
(4-year; Graduate)

Texas
University of Houston
Chemical Engineering Department
4800 Calhoun
Houston, Texas 77004
(4-year; Graduate)

Virginia
George Washington University—NASA
Joint Institute for Advancement of Flight Sciences Department
Mail Stop 169
NASA-Langley Research Center
Hampton, Virginia 23665
(Graduate)

Wisconsin
Alverno College
Environmental Division
3401 S. 39th Street
Milwaukee, Wisconsin 53215
(4-year)

University of Wisconsin at Milwaukee
Atmospheric & Marine Environmental Studies Program
Energetics Department
Room 819
Engineering & Mathematical Sciences Building
Milwaukee, Wisconsin 53201
(Graduate)

4. Noise Programs

Connecticut
University of Hartford
Interdisciplinary Engineering Studies
200 Bloomfield Avenue
West Hartford, Connecticut 06117
(4-year)

Georgia
Georgia Institute of Technology
College of Engineering
225 North Ave., N.W.
Atlanta, Georgia 30332
(Certificate; 4-year)

Illinois
Northern Illinois University
Physics Department
DeKalb, Illinois 60115
(Certificate; 4-year; Graduate)

Indiana
Purdue University
School of Mechanical Engineering
West Lafayette, Indiana 47907
(Graduate)

Maine
University of Maine
. Electrical Engineering Department
111 Barrows Hall
Orono, Maine 04473
(Graduate)

Massachusetts
Massachusetts Institute of Technology
Mechanical Engineering Department
Cambridge, Massachusetts 02139
(Graduate)

Northeastern University
Mechanical Engineering Department
214 Hayden Hall
360 Huntington Avenue
Boston, Massachusetts 02115
(Graduate)

University of Lowell
Mechanical Engineering Department
1 University Avenue
Lowell, Massachusetts 01854
(Graduate)

New Jersey
Rutgers, The State University of New Jersey
Mechanical & Aerospace Engineering Department
B241 Engineering Building
Busch Campus
New Brunswick, New Jersey 08903
(Graduate)

North Carolina
North Carolina State University
Mechanical and Aerospace Engineering Department
Raleigh, North Carolina 27607
(Graduate)

Ohio
University of Cincinnati
Mechanical and Industrial Engineering Department
College of Engineering
Cincinnati, Ohio 45267
(4-year; Graduate)

Pennsylvania
The Pennsylvania State University
Graduate Program in Acoustics
Applied Research Laboratory
P.O. Box 30
State College, Pennsylvania 16801
(Graduate)

Tennessee
Memphis State University
Audiology and Speech Pathology
Speech and Hearing Center
807 Jefferson Avenue
Memphis, Tennessee 38152
(Graduate)

University of Tennessee
Audiology and Speech Pathology Department
Knoxville, Tennessee 37916
(Graduate)

Texas
University of Houston
Mechanical Engineering Department
4800 Calhoun
Houston, Texas 77004
(4-year; Graduate)

Virginia
George Washington University
NASA
Joint Institute for Advancement of Flight Sciences
Mail Stop 169
NASA-Langley Research Center
Hampton, Virginia 23665
(Graduate)

5. Pesticides and Toxicology Programs

Alabama
Alabama A & M University
Biology Department
Normal, Alabama 35762
(4-year)

Gadsden State Junior College
Division of Vocational/Technical Education
George Wallace Drive
Gadsden, Alabama 35903
(2-year)

Arizona
Arizona State University
Zoology Department
Tempe, Arizona 85281
(4-year)

University of Arizona
Toxicology Department
Tucson, Arizona 85721
(Graduate)

University of Arizona
Plant Sciences Department
Tucson, Arizona 85721
(4-year; Graduate)

University of Arizona
Entomology Department
Tucson, Arizona 85721
(4-year; Graduate)

University of Arizona
Interdepartmental Program
Plant Protection Committee
Tucson, Arizona 85721
(4-year)

Arkansas
University of Arkansas
Interdepartmental Program
College of Agriculture and Home Economics
Fayetteville, Arkansas 72701
(4-year)

University of Arkansas
Entomology Department
Fayetteville, Arkansas 72701
(4-year; Graduate)

University of Arkansas Medical Center
Pediatrics Department
4301 West Markham
Little Rock, Arkansas 72701
(Graduate)

University of Arkansas Medical Center
Interdisciplinary Toxicology Graduate Program
4301 West Markham,
Little Rock, Arkansas 72201
(Graduate)

California
California State University at Northridge
Health Science Department
18111 Northhoff Street
Northridge, California 91330
(4-year; Graduate)

Consumnes River College
Agriculture Department
8401 Center Parkway
Sacramento, California 95823
(2-year)

Reedley College
Plant Science Program
995 North Reed Avenue
Reedley, California 93654
(Certificate; 2-year)

Saddleback College
Agriculture Department
2800 Marguerite Parkway
Mission Viejo, California 92675
(Certificate)

San Jose State University
Biological Sciences Department
125 South Seventh Street
San Jose, California 95192
(4-year; Graduate)

University of California at Berkeley
Entomology Department
Berkeley, California 94720
(4-year; Graduate)

University of California at Berkeley
Pest Management Program
Berkeley, California 94720
(4-year)

University of California at Davis
Interdepartmental Program on Plant Protection and Pest Management
Davis, California 95616
(Graduate)

University of California at Davis
Environmental Toxicology Program
College of Agriculture and Environmental Science
Davis, California 95616
(Graduate)

University of California at Davis
Plant Sciences and Pest & Disease Management Program (Entomology)
Davis, California 95616
(4-year; Graduate)

University of California at Davis
Resources Sciences and Engineering Department
Davis, California 95616
(4-year)

University of California at Davis
Graduate Group in Pharmacology and Toxicology
Graduate Division
Davis, California 95616
(Graduate)

University of California at Davis
Medical Learning Resources
School of Medicine
Davis, California 95616
(Graduate)

University of California at Riverside
Entomology Department
Riverside, California 92502
(4-year; Graduate)

Colorado
Colorado State University
Zoology and Entomology Department
Fort Collins, Colorado
80523
(4-year; Graduate)

Delaware
University of Delaware
Entomology and Applied Ecology Department
Newark, Delaware 19711
(4-year)

Florida
Broward Community College
Division of Mathematics and Science
3501 S.W. Davie Road
Fort Lauderdale, Florida 33314
(2-year)

Florida A & M University
Division of Rural Development
Entomology and Structural Pest Control Program
Tallahassee, Florida 32307
(4-year)

University of Florida
Pest Management Program
College of Agriculture
Gainesville, Florida 32611
(4-year; Graduate)

Georgia

University of Georgia
Entomology Department
Athens, Georgia 30602
(4-year; Graduate)

University of Georgia
Plant Pathology and Genetics Program
Athens, Georgia 30602
(4-year; Graduate)

Idaho

Idaho State University
College of Pharmacy
Pacatello, Idaho 83209
(Graduate)

University of Idaho
College of Agriculture
Moscow, Idaho 83843
(4-year; Graduate)

Illinois

Elgin Community College
Technical/Vocational Program
1700 Spartan Drive
Elgin, Illinois 60120
(2-year)

Loyola University of Chicago
Pharmacology Department
Stritch School of Medicine
2160 South First Avenue
Maywood, Illinois 60153
(Graduate)

University of Illinois at Urbana-Champaign
Entomology Department
Urbana, Illinois 61801
(Graduate)

University of Illinois at Urbana-Champaign
Interdepartmental Program in Environmental Toxicology
583 Morrill Hall
Urbana, Illinois 61801
(Graduate)

Indiana

Indiana University
School of Medicine
1100 W. Michigan St.
Indianapolis, Indiana 46202
(Graduate)

Purdue University
School of Pharmacology & Toxicology
West Lafayette, Indiana 47907
(4-year)

Purdue University
School of Agriculture (Entomology)
West Lafayette, Indiana 47907
(4-year)

Iowa

Drake University
College of Pharmacy
25th and University
Des Moines, Iowa 50311
(Graduate)

University of Iowa
Institute of Agricultural Medicine and Environmental Health, Oakdale Campus
Iowa City, Iowa 52242
(Graduate)

Kansas

Kansas State University
Comparative Toxicology Laboratory
College of Veterinary Medicine
Manhattan, Kansas 66506
(4-year; Graduate)

Kansas State University
Entomology Department
Manhattan, Kansas 66506
(4-year; Graduate)

University of Kansas
School of Pharmacy
Lawrence, Kansas 66045
(4-year; Graduate)

The University of Kansas Medical Center
Pharmacology Department
College of Health Sciences and Hospital
Kansas City, Kansas 66103
(Graduate)

Kentucky

University of Kentucky
Biological Sciences Department
Lexington, Kentucky 40506
(4-year; Graduate)

University of Kentucky
Environmental Toxicology Department
Lexington, Kentucky 40506
(Graduate)

Louisiana

Delgado College
Environmental Health Technology Department
615 Park Avenue
New Orleans, Louisiana 70119
(2-year; Certificate)

Louisiana State University
Entomology Department
Baton Rouge
Louisiana 70803
(4-year)

Northeast Louisiana University
School of Pharmacy
Monroe, Louisiana 71201
(4-year; Graduate)

Maine

University of Maine at Orono
Entomology Department
306 Deering Hall
Orono, Maine 04473
(4-year; Graduate)

Maryland

University of Maryland
Department of Entomology
Symons Hall
Room 1304
College Park, Maryland 20742
(Graduate)

Massachusetts

Harvard University School of Public Health
Physiology Department
665 Huntington Avenue
Boston, Massachusetts 02115
(Graduate)

North Shore Community College
Essex Agricultural and Technical Institute
3 Essex Street
Beverly, Massachusetts 01915
(2-year)

University of Massachusetts at Amherst
Entomology Department
Amherst, Massachusetts 01002
(4-year; Graduate)

University of Massachusetts at Amherst
College of Food and Natural Resources
Amherst, Massachusetts 01002
(4-year)

Michigan

Ferris State College
School of Allied Health (Pesticide Technology)
Big Rapids, Michigan 49307
(2-year)

Michigan State University
Pesticide Research Center
East Lansing, Michigan 48824
(no degree)

Michigan State University
Colleges of Agriculture and Natural Resources and Natural Science
203 Pesticide Research Center
East Lansing, Michigan 48824
(4-year)

University of Michigan
Environmental & Industrial Health Department
Toxicology Research Lab
3550 School of Public Health
Ann Arbor, Michigan 48109
(Graduate)

Mississippi

Mississippi State University
College of Agriculture and Home Economics
Entomology Department
Mississippi State, Mississippi 39762
(4-year)

Mississippi State University
Entomology
Plant Pathology and Weed Science
Mississippi State, Mississippi 39762
(Graduate)

University of Mississippi
School of Pharmacy
Oxford Campus
University, Mississippi 38677
(Graduate)

University of Mississippi Medical Center
Department of bhharmacology and Toxicology
2500 North State Street
Jackson, Mississippi 39216
(Graduate)

Missouri

State Fair Community College
Vocational/Technical Education Department
1900 Clarendon Road
Sedalia, Missouri 65301
(2-year)

Nebraska

Central Technical Community College
Agriculture/Environmental Technology Division
Box 1024
Hastings, Nebraska 68901
(1-year; 2-year)

University of Mid-America
Office of Marketing (Pests, Pesticides & Pesticides Safety)
P.O. Box 82006
Lincoln, Nebraska 68501
(Graduate)

University of Nebraska Medical Center
Department of Pharmacodynamics and Toxicology
Omaha, Nebraska 68105
(Graduate)

Nevada

University of Nevada
College of Agriculture
Reno, Nevada 89557
(4-year; Graduate)

New Hampshire

University of New Hampshire
College of Life Sciences and Agriculture
Durham, New Hampshire 03824
(2-year; 4-year; Graduate)

New Jersey

Rutgers, State University of New Jersey
Graduate Programs in Entomology and Economic Zoology
New Brunswick, New Jersey 08903
(4-year; Graduate)

New Mexico

New Mexico State University
School of Botany and Entomology
Las Cruces, New Mexico 88003
(4-year)

University of New Mexico
Pharmacology Department
College of Pharmacy
Albuquerque, New Mexico 87131
(4-year)

New York

Saint John's University
College of Pharmacy and Allied Health Professions
Jamaica, New York 11439
(4-year; Graduate)

State University of New York at Alfred
Agricultural & Technical Colege
Alfred, New York 14802
(2-year)

State University of New York at Farmingdale
Biological Technology Program
Melville Road
Farmingdale, New York 11735
(2-year)

State University of New York at Syracuse
College of Environmental Science and Forestry
Syracuse, New York 13210

(Graduate)

University of Rochester
School of Pharmacology and Toxicology
Rochester, New York 14642
(Graduate)

Westchester Community College
Toxicology Program
75 Grasslands Road
Valhalla, New York 10595
(2-year)

North Carolina

Anson Technical Institute
Agriculture Department
P.O. Box 68
Ansonville, North Carolina 28007
(2-year)

Duke University
School of Forestry and Environmental Studies
Duke Station
Durham, North Carolina 27706
(Graduate)

North Carolina State University
Interdepartmental Program on Biochemical and Environmental Toxicology
Raleigh, North Carolina 27607
(Graduate)

North Carolina State University
Interdepartmental Program in the School of Agriculture and Life Sciences
Raleigh, North Carolina 27611
(2-year; 4-year; Graduate)

Pitt Technical Institute
Agricultural Programs
P.O. Drawer 7007
Greenville, North Carolina 27834
(2-year)

Robeson Technical Institute
Pesticides and Fertilizers Program
Drawer A
Lumberton, North Carolina 28358
(2-year)

University of North Carolina at Chapel Hill
Schools of Pharmacy and Public Health
Chapel Hill, North Carolina 27514
(Graduate)

North Dakota

North Dakota State University
College of Pharmacy
Fargo, North Dakota 58102
(4-year; Graduate)

North Dakota State University
Entomology Department
Fargo, North Dakota 58102
(4-year)

Ohio

Cleveland State University
Toxicology Program
2065 Adelbert Road
Cleveland, Ohio 44106
(Graduate)

Ohio State University
College of Medicine (Pharmacology)
333 West Tenth Street
Columbus, Ohio 43210
(Graduate)

University of Cincinnati
Department of Environmental Health
311 Kettering Laboratory
Cincinnati, Ohio 45267
(Graduate)

Oklahoma

Northeastern Oklahoma A & M College
Agricultural Science and Industry Division
Second and I Streets, N.E.
Miami, Oklahoma 74354
(2-year)

Oklahoma State University
Entomology Department
Stillwater, Oklahoma 74074
(4-year; Graduate)

Oklahoma State University
Plant Pathology Department
Stillwater, Oklahoma 74074
(4-year; Graduate)

University of Oklahoma
Pharmacodynamics and Toxicology Department
College of Pharmacy
644 N.E. 14th Street HSC
Oklahoma City, Oklahoma 73190
(Graduate)

Oregon

Clackamas Community College
Agriculture Department
19600 South Molalla Avenue
Oregon City, Oregon 97045
(2-year)

Clatsop Community College
Program on Pest Management for Plant Protection
Astoria, Oregon 97103
(2-year)

Oregon State University
School of Pharmacy
Corvallis, Oregon 97331
(4-year; Graduate)

Oregon State University
Entomology Department
Corvallis, Oregon 97331
(4-year; Graduate)

Pennsylvania

Pennsylvania State University
College of Agriculture/Entomology
106 Patterson Building
University Park, Pennsylvania 16802
(4-year; Graduate)

Rhode Island

University of Rhode Island
School of Pharmacy
Kingston, Rhode Island 02881
(Graduate)

University of Rhode Island
Food Sciences Program
Kingston, Rhode Island 02881
(Graduate)

University of Rhode Island
Biological Sciences Department (Entomology)
Kingston, Rhode Island 02881
(Graduate)

South Carolina

Clemson University
Entomology and Economic Zoology Department
Clemson, South Carolina 29631
(Graduate)

Sumter Area Technical College
Technical Division (Agricultural Chemicals and Mechanization Technology)
506 Guignard Drive
Sumter, South Carolina 29150
(2-year)

South Dakota

South Dakota State University
Entomology and Zoology Department
Brookings, South Dakota 57006
(4-year; Graduate)

South Dakota State University
College of Pharmacy
Brookings, South Dakota 57006
(4-year)

Tennessee

Meharry Medical College
Pharmacology Department
1005 18th Avenue North
Nashville, Tennessee 37208
(Graduate)

Texas

Texas A&M University at College Station
Plant Sciences Department
College Station, Texas 77843
(4-year)

Texas A&M University at College Station
Entomology Department
College Station, Texas 77843
(4-year)

Texas A&M University at College Station
Entomology Department
College Station, Texas 77843
(Graduate)

Texas A&M University at Kingsville
College of Agriculture
Kingsville, Texas 78363
(4-year; Graduate)

Texas Tech University
Entomology Department
Lubbock, Texas 79409
(4-year; Graduate)

University of Texas Health Science Center
Pharmacology Department
7703 Floyd Curl Drive
San Antonio, Texas 78284
(Graduate)

University of Texas Medical Branch
Preventative Medicine and Community Health Department
301 University Blvd.
Graduate School of Biomedical Science
Galveston, Texas 77550
(Graduate)

Utah

University of Utah
Colleges of Pharmacy and Medicine
(Pharmacology and Toxicology)
Salt Lake City, Utah 84132
(Graduate)

Utah State University
College of Agriculture
UMC 56
Logan, Utah 84322
(Graduate)

Washington

Washington State University
Entomology Department
Pullman, Washington 99163
(4-year; Graduate)

West Virginia

West Virginia University
Division of Plant Sciences
Morgantown, West Virginia 26506
(4-year)

West Virginia University
College of Agriculture and Forestry (Plant and Soil Sciences)
Morgantown, West Virginia 26506
(4-year)

Wisconsin

University of Wisconsin
Environmental Toxicology Department
School of Pharmacy
425 N. Charter Street
Madison, Wisconsin 53706
(4-year; Graduate)

University of Wisconsin
Center for Environmental Toxicology
1550 Linden Drive
Madison, Wisconsin 53706
(Graduate)

Wyoming

University of Wyoming
Plant Science Division
Entomology Section
P.O. Box 3334
University Station
Laramie, Wyoming 82071
(4-year; Graduate)

6. Solid Waste Programs

Iowa

University of Iowa
Environmental Sciences Department
Iowa City, Iowa 52242
(4-year)

Michigan

University of Michigan
Solid Waste Program
College of Engineering
Ann Arbor, Michigan 48109
(Graduate)

New York

Hofstra University
Continuing Engineering Education Department
Hempstead, New York 11550
(Certificate)

North Carolina

Duke University
Civil Engineering Department
Durham, North Carolina 27706
(Graduate)

Ohio

Ohio State University
Civil Engineering Department
N 470 Hitchcock Hall
2070 Neil Avenue
Columbus, Ohio 43210
(Graduate)

Tennessee

University of Tennessee
Civil Engineering Department
Knoxville, Tennessee 37916
(4-year; Graduate)

Vanderbilt University
Environmental Engineering & Policy Management Department
Nashville, Tennessee 37240
(4-year; Graduate)

Wisconsin

University of Wisconsin at Green Bay
College of Environmental Science
Green Bay, Wisconsin 54302
(Graduate)

University of Wisconsin at Madison
Civil & Environmental Engineering Department
2205 Engineering Building
Madison, Wisconsin 53706
(4-year)

7. Radiation Programs

California

Orange Coast College
Division of Consumer and Health Science
2701 Fairview Road
Costa Mesa, California 92626
(2-year)

Stanford University
School of Medicine
Radiology Department
Palo Alto, California 94305
(Graduate)

University of California at Irvine
School of Medicine
Radiological Sciences Department
Irvine, California 92664
(Graduate)

Colorado

Colorado State University
Radiology and Radiation Biology Department
Fort Collins, Colorado 80523
(Graduate)

University of Colorado Medical Center
Radiology Department
Denver, Colorado 80262
(Graduate)

Connecticut

Hartford State Technical College
Nuclear Technology Department
401 Flatbush Avenue
Hartford, Connecticut 06106
(2-year)

Florida

Central Florida Community College
Radiological Health Technology Department
P.O. Box 1388
Ocala, Florida 32670
(2-year)

University of Florida
Department of Environmental Engineering Sciences
Gainesville, Florida 32611
(Graduate)

University of Florida
Nuclear Engineering Sciences Department
Gainesville, Florida 32611
(4-year; Graduate)

Georgia
Georgia Institute of Technology
School of Nuclear Engineering
225 North Avenue N.W.
Atlanta, Georgia 30332
(4-year; Graduate)

Medical College of Georgia
School of Allied Health Sciences
1120 15th Street
Augusta, Georgia 30901
(2-year; 4-year)

Southern Technical Institute
Electrical Engineering Technology Department
(Nuclear Safety Option)
534 Clay Street
Marietta, Georgia 30060
(2-year)

Idaho
Idaho State University
School of Engineering
Pocatello, Idaho 83209
(Certificate)

University of Idaho
Nuclear Engineering Department
Moscow, Idaho 83843
(Graduate)

Illinois
University of Illinois at Urbana-Champaign
Nuclear Engineering Program
Urbana, Illinois 61801
(4-year; Graduate)

Indiana
Purdue University
Department of Bionucleonics
West Lafayette, Indiana 47907
(Graduate)

Kansas
University of Kansas
Department of Radiation Biophysics
140 Nuclear Reactor Center
Lawrence, Kansas 66045
(4-year; Graduate)

Kentucky
University of Kentucky
College of Medicine
Department of Radiation Medicine
Lexington, Kentucky 40506
(Graduate)

Louisiana
Louisiana State University
Department of Engineering and Industrial Technology
Nuclear Science Center
Baton Rouge, Louisiana 70803
(Certificate; 4-year; Graduate)

Massachusetts
University of Lowell
Radiological Sciences Program
1 University Avenue
Lowell, Massachusetts 01854
(4-year; Graduate)

Michigan
University of Michigan
Department of Environmental and Industrial Health
School of Public Health
Ann Arbor, Michigan 48104
(Graduate)

Nevada
University of Nevada at Las Vegas
College of Allied Health Professions
4505 Maryland Parkway
Las Vegas, Nevada 89154
(2-year; 4-year)

New Jersey
Rutgers, The State University of New Jersey
Graduate Programs in Radiation Science
Room 116
Doolittle Building
Busch Campus
New Brunswick, New Jersey 08903
(Graduate)

New York
State University of New York at Buffalo
Department of Biological Sciences
Division of Biology
101 Cary Hall
Buffalo, New York 14214
(4-year)

North Carolina
Queens College
Nuclear Medical Technology Department
1900 Sewlyn Avenue
Charlotte, North Carolina 28274
(2-year; 4-year)

University of North Carolina at Chapel Hill
Environmental Sciences and Engineering
School of Public Health
Chapel Hill, North Carolina 27514
(Graduate)

Oklahoma
Oklahoma State University
Radiation and Nuclear Technology Department
Stillwater, Oklahoma 74074
(4-year)

Oregon
Oregon State University
General Sciences Department
Corvallis, Oregon 97331
(4-year; Graduate)

Pennsylvania
Duquesne University
Radiological Health Department
School of Pharmacy
Pittsburgh, Pennsylvania 15219
(4-year)

University of Pittsburgh
Graduate School of Public Health
130 DeSoto Street
Pittsburgh, Pennsylvania 15261
(Graduate)

Puerto Rico
University of Puerto Rico
Engineering Department
Mayaguez Campus
Mayaguez, Puerto Rico 00708
(Graduate)

Tennessee
Chattanooga State Technical Community College
Division of Engineering Technologies
4501 Amnicola Highway
Chattanooga, Tennessee 37406
(2-year)

Memphis State University
Center for Nuclear Studies
Memphis, Tennessee 38152
(Certificate)

Middle Tennessee State University
Department of Chemistry and Physics
Murfreesboro, Tennessee 37132
(4-year)

Oak Ridge Associated Universities
Medical and Health Sciences Division
P.O. Box 117
Oak Ridge, Tennessee 37830
(Certificate)

University of Tennessee
Nuclear Engineering Department
Knoxville, Tennessee 27916
(4-year; Graduate)

Texas
Texas A&M University
Nuclear Engineering Department
College Station, Texas 77843
(4-year; Graduate)

Washington
University of Washington
Radiological Sciences Group of the Graduate School
Radiological Sciences SB-30
Seattle, Washington 98195
(Graduate)

8. Energy Programs

Alabama
University of Alabama
College of Engineering
University, Alabama 35486
(4-year)

Arizona
University of Arizona
Nuclear Engineering Department
Tucson, Arizona 85721
(4-year; Graduate)

California
California Institute of Technology
Mechanical Engineering Department
1201 East California Blvd.
Pasadena, California 91125
(4-year; Graduate)

Stanford University
Mechanical Engineering Department
Palo Alto, California 94305
(Graduate)

University of California at Berkeley
Nuclear Engineering Department
Berkeley, California 94720
(4-year; Graduate)

University of California at Santa Barbara
Chemical and Nuclear Engineering Department
Santa Barbara, California 93106
(4-year; Graduate)

Colorado

Colorado Mountain College
Environmental Protection Technology
Leadville, Colorado 80461
(2-year)

Colorado School of Mines
Department of Chemical and Petroleum
Refining Engineering
Golden, Colorado 80401
(4-year; Graduate)

Colorado School of Mines
Petroleum Engineering
Golden, Colorado 80401
(4-year; Graduate)

Colorado School of Mines
Mining Engineering Department
Golden, Colorado 80401
(4-year; Graduate)

Mesa College
School of Natural Sciences and Mathematics
North Avenue at 12th Street
P.O. Box 2647
Grand Junction, Colorado 81501
(4-year)

Trinidad State Junior College
Mining Technology Department
Trinidad, Colorado 81082
(Certificate; 2-year)

Delaware

University of Delaware
Department of Entomology and Applied
Ecology
Newark, Delaware 19711
(Graduate)

District of Columbia

George Washington University
Continuing Engineering Education in
Environment and Energy
School of Engineering & Applied Science
Washington, D.C. 20052
(No degree)

Florida

University of Florida
Department of Mechanical Engineering
College of Engineering
Gainesville, Florida 32611
(4-year)

University of Florida
Department of Nuclear Engineering Sciences
Gainesville, Florida 32611
(4-year; Graduate)

University of Florida
Department of Electrical Engineering
Gainesville, Florida 32611
(4-year; Graduate)

University of Miami
Mechanical Engineering Department
University Station
Coral Gables, Florida 33124
(4-year; Graduate)

Georgia

Georgia Institute of Technology
College of Engineering
225 North Avenue, N.W.
Atlanta, Georgia 30332
(Certificate; 4-year; Graduate)

Georgia Institute of Technology
School of Nuclear Engineering
225 North Avenue, N.W.
Atlanta, Georgia 30332
(4-year; Graduate)

Idaho

Idaho State University
School of Engineering (Nuclear Science)
Pocatello, Idaho 83209
(4-year; Graduate)

University of Idaho
Nuclear Engineering Program
Moscow, Idaho 83843
(Graduate)

University of Idaho
Department of Mining Engineering and
Metallurgy
Moscow, Idaho 83843
(4-year; Graduate)

Illinois

Eastern Illinois University
School of Business (Energy)
Charleston, Illinois 61920
(4-year)

University of Illinois at Urbana-Champaign
Nuclear Engineering Department
Urbana, Illinois 61801
(4-year, Graduate)

University of Illinois at Urbana-Champaign
Department of Mechanical and Industrial
Engineering
Urbana, Illinois 61801
(4-year; Graduate)

Indiana

Indiana Institute
Department of Engineering
Nuclear Engineering Program
1600 E. Washington Blvd.
Fort Wayne, Indiana 46803
(4-year)

Purdue University
School of Nuclear Engineering
Engineering Building
Room 250
West Lafayette, Indiana 47907
(4-year; Graduate)

Iowa

Iowa State University
Nuclear Engineering Department
Ames, Iowa 50011
(4-year; Graduate)

Kansas

Kansas State University
Department of Nuclear Engineering
Manhattan, Kansas 66506
(4-year; Graduate)

Kansas State University
Department of Chemical Engineering
Durland Hall
Manhattan, Kansas 66506
(4-year; Graduate)

Kentucky

Hazard Community College
Coal Mining Technology Program
Hazard, Kentucky 41701
(2-year)

Lees Junior College
Division of Science and Mathematics
Jackson, Kentucky 41339
(2-year)

Madisonville Community College
Coal Mining Technology Program
Madisonville, Kentucky 42431
(2-year)

Morehead State University
Applied Science and Technology Department
Morehead, Kentucky 40351
(2-year)

Pikeville College
Department of Mining Technology
Pikeville, Kentucky 41501
(2-year)

Southeast Community College
Division of Natural Sciences and Related
Technologies
Cumberland, Kentucky 40823
(2-year)

University of Kentucky
Department of Civil Engineering (Mine
Engineering)
Lexington, Kentucky 40506
(4-year; Graduate)

University of Kentucky
Department of Mechanical Engineering
(Nuclear Energy Program)
Lexington, Kentucky 40506
(4-year; Graduate)

University of Kentucky
Department of Chemical Engineering
Lexington, Kentucky 40506
(4-year; Graduate)

Louisiana

Delgado College
Petroleum Engineering Technology Program
615 Park Avenue
New Orleans, Louisiana 70119
(2-year)

Louisiana State University
Department of Petroleum Engineering
Baton Rouge, Louisiana 70803
(4-year; Graduate)

Louisiana Tech University
Department of Petroleum Engineerng
P.O. Box 4875 Tech Station
Ruston, Louisiana 71272
(2-year; 4-year; Graduate)

Maine

University of Maine
College of Engineering and Sciences, Physics
and Engineering
Orono, Maine 04473
(4-year)

Maryland

Dundalk Community College
Math/Science Division
7200 Sollers Point Road
Baltimore, Maryland 21222
(Certificate; 2-year)

University of Maryland
College of Engineering
Department of Chemical and Nuclear
Engineering
College Park, Maryland 20742
(4-year)

Massachusetts

Boston University
Center for Energy Studies
Engineering Department
110 Cunnington Street
Boston, Massachusetts 02215
(1-year)

Massachusetts Institute of Technology
Department of Nuclear Engineering
Cambridge, Massachusetts 02139
[illegible] Graduate)

Massachusetts Institute of Technology
Mineral Resources Engineering and
Management Program
School of Engineering
Cambridge, Massachusetts 02139
(Graduate)

Worcester Polytechnic Institute
Nuclear Engineering Program
Worcester, Massachusetts 01609
(4-year; Graduate)

Michigan

Lansing Community College
Engineering Technology Department
419 N. Capitol Avenue
Box 40010
Lansing, Michigan 48901
(4-year)

University of Detroit
Mechanical Engineering Department
4001 W. McNichols Road
Detroit, Michigan 48221
(4-year; Graduate)

Mississippi

Mississippi State University
College of Engineering (Nuclear Engineering;
Petroleum Engineering)
Mississippi State, Mississippi 39762
(4-year; Graduate)

Mississippi State University
Geology Department (Petroleum and Coal)
Mississippi State, Mississippi 39762
(4-year; Graduate)

Montana

Montana College of Mineral Science and
Technology
Petroleum Engineering Department
Butte, Montana 59701
(4-year; Graduate)

Montana College of Mineral Science and
Technology
Mine Engineering Department
Butte, Montana 59701
(4-year; Graduate)

Nevada

Sierra Nevada College
Alternative Energy Sources Program
P.O. Box 4269
800 Campbell Road
Incline Village, Nevada 89450
(4-year)

University of Nevada at Reno
Mining Engineering Department
Reno, Nevada 89557
(4-year; Graduate)

New Jersey

Monmouth College
Physics Department
West Long Branch, New Jersey 07764
(4-year)

Princeton University
School of Engineering and Applied Science
Princeton, New Jersey 08540
(4-year; Graduate)

New Mexico

New Mexico Institute of Mining and
Technology
Petroleum and Mining Engineering Department
Socorro, New Mexico 87801
(4-year; Graduate)

New Mexico Institute of Mining and
Technology
Department of Geoscience
Socorro, New Mexico 87801
(4-year; Graduate)

New Mexico State University
Department of Mechanical Engineering
Las Cruces, New Mexico 88001
(4-year; Graduate)

University of New Mexico
College of Engineering
Albuquerque, New Mexico 87131
(4-year; Graduate)

New York

Columbia University
College of Engineering and Applied Science
Seeley W. Mudd Building
New York, New York 10027
(4-year; Graduate)

Cornell University
Ward Laboratory
Department of Nuclear Science and
Engineering
Ithaca, New York 14853
(4-year)

New York University
Interdisciplinary Program in Applied Science
Washington Square Center
New York City, New York 10003
(Graduate)

Polytechnic Institute of New York
Engineering Division
Brooklyn, New York 11201
(Certificate; Graduate)

Rensselaer Polytechnic Institute
Center for Electric Power Engineering
Troy, New York 12181
(4-year; Graduate)
Renssalaer Polytechnic Institute
Nuclear Engineering Department
Troy, New York 12181
(4-year; Graduate)

State University of New York Maritime
College
Nuclear Science Department
Fort Schulyer, New York 10465
(4-year)

State University of New York at Stony Brook
Laboratory for Energy Technology
College of Engineering and Applied Science
Stony Brook, New York 11794
(Graduate)

North Carolina

North Carolina State University
Nuclear Engineering Department
Raleigh, North Carolina 27607
(4-year; Graduate)

North Carolina State University
Physics Department
Raleigh, North Carolina 27607
(Graduate)

Wake Technical Institute
Nuclear Engineering Technology Program
Route 10
Box 200
Raleigh, North Carolina 27603
(2-year)

Ohio

Muskingum Area Technical College
Division of Engineering and Science
1555 Newark Road
Zanesville, Ohio 43701
(1-year; 2-year)

Ohio State University
Mechanical Engineering Department (Nuclear
Program)
1133 Robinson Laboratory
206 West 18th Avenue
Columbus, Ohio 43210
(Graduate)

Oklahoma

Oklahoma State University
Nuclear Engineering Department
Stillwater, Oklahoma 74074
(Graduate)

Oklahoma State University
Petroleum Engineering Technology Program
Stillwater, Oklahoma 74074
(4-year)

University of Oklahoma
College of Engineering (Mechanical,
Chemical, Petroleum, Nuclear)
Norman, Oklahoma 73019
(4-year; Graduate)

University of Tulsa
College of Engineering
Division of Resources Engineering
600 South College Avenue
Tulsa, Oklahoma 74107
(4-year)

Oregon

Oregon State University
School of Engineering (Nuclear, Mining)
Corvallis, Oregon 97331
(4-year; Graduate)

Pennsylvania

Carnegie-Mellon University
Nuclear Science and Engineering Division
5000 Forbes Avenue
Pittsburgh, Pennsylvania 15213
(4-year; Graduate)

Community College of Beaver County
Nuclear Quality Assurance Technology Program
College Drive
Monaca, Pennsylvania 15061
(2-year)

East Stroudsberg State College
Institute of Industrial and Energy Technology
East Stroudsberg, Pennsylvania 18301
(No degree)

Pennsylvania State University
General Engineering Department
University Park, Pennsylvania 16802
(2-year)

Pennsylvania State University
Department of Petroleum and Natural Gas Engineering
25 Mineral Industries Building
University Park, Pennsylvania 16802
(Graduate)

Pennsylvania State University
Department of Petroleum and Natural Gas Engineering (Mining)
118 Mineral Sciences Building
University Park, Pennsylvania 16802
(2-year; 4-year; Graduate)

Pennsylvania State University
Department of Material Sciences (Metallurgy)
209 Mineral Industries Building
University Park, Pennsylvania 16802
(4-year; Graduate)

Pennsylvania State University
College of Engineering
Nuclear Engineering Department
231 Sackett Building
University Park, Pennsylvania 16802
(4-year; Graduate)

Pennsylvania State University
Mineral Engineering Department
109 Mineral Industries Building
University Park, Pennsylvania 16802
(Graduate)

Pennsylvania State University
Mineral Economics Department
220 Walker Building
University Park, Pennsylvania 16802
(4-year)

Pennsylvania State University
Department of Nuclear Engineering
231 Sackett Building
University Park, Pennsylvania 16802
(2-year)

University of Pennsylvania
Energy Engineering Program
Philadelphia, Pennsylvania 19174
(Graduate)

University of Pittsburgh
School of Engineering
Interdisciplinary Energy Resources Program
1140 Benedum Hall
Pittsburgh, Pennsylvania 15261
(Graduate)

University of Pittsburgh
Department of Chemistry and Petroleum Engineering
4200 Fifth Avenue
Pittsburgh, Pennsylvania 15260
(4-year; Graduate)

Puerto Rico

University of Puerto Rico
Nuclear Engineering Department
Mayaguez Campus
Mayaguez, Puerto Rico 00708
(Graduate)

Rhode Island

Roger Williams College
Division of Engineering
Bristol, Rhode Island 02809
(2-year)

University of Rhode Island
Chemical Engineering Department (Energy Specialization)
Kingston, Rhode Island 02881
(Graduate)

South Carolina

Aiken Technical Education Center
Engineering and Industrial Technologies Division
P.O. Drawer 696
Aiken, South Carolina 29801
(2-year)

Florence-Darlington Technical College
Division of Engineering Technology (Nuclear Specialization)
P.O. Drawer 8000
Florence, South Carolina 29501
(2-year)

Tri County Technical College
Nuclear Engineering Technology Department
P.O. Box 87
Pendleton, South Carolina 29670
([illegible]-year)

Trident Technical College
Chemical and Nuclear Engineering
Central Office
5290 Rivers Avenue
North Charleston, South Carolina 29406
(2-year)

University of South Carolina
College of Engineering
Nuclear Engineering
Columbia, South Carolina 29208
(4-year; Graduate)

University of South Carolina
Geology Department (Coal Formation)
Columbia, South Carolina 29208
(4-year; Graduate)

South Dakota

South Dakota School of Mines and Technology
Mining Engineering Department
Rapid City, South Dakota 57701
(4-year; Graduate)

Tennessee

Memphis State University
Center for Nuclear Studies
Memphis, Tennessee 38152
(Certificate)

Memphis State University
Mechanical Engineering Department (Energy Management)
Memphis, Tennessee 38152
(Graduate)

Roane State Community College
Division of Career Education (Nuclear Engineering Technology)
Harriman, Tennessee 37748
(2-year)

University of Tennessee
Nuclear Engineering Department
Knoxville, Tennessee 37916
(4-year; Graduate)

Vanderbilt University
Department of Mechanical Engineering and Materials Science
Nashville, Tennessee 37240
(4-year; Graduate)

Texas

Kilgore College
Occupational Education
Oil and Gas Technology 1100 Broadway
Kilgore, Texas 75662
(2-year)

Kilgore College
Engineering-Science Division
Petroleum Engineering
1100 Broadway
Kilgore, Texas 75662
(2-year)

Lamar University
Geology Department
Energy Resources Management
Beaumont, Texas 77710
(4-year)

Lee College
Occupational Education and Technology
Petroleum and Chemical Process Technology
P.O. Box 818

Baytown, Texas 77520
(2-year)

Midland College
Petroleum Technology Department
3600 North Garfield
Midland, Texas 79701
(2-year)

Texas A&M University
Petroleum Engineering Department
College Station, Texas 77843
(4-year; Graduate)

Texas A&M University
Nuclear Engineering Department
College Station, Texas 77843
(Graduate)

Texas State Technical Institute
Nuclear Technology Program
Waco, Texas 76705
(2-year)

Texas Tech University
Petroleum Engineering Department
Lubbock, Texas 79409
(4-year)

Tyler Junior College
Petroleum Technology Department
Tyler, Texas 75701
(2-year)

University of Texas at Austin
College of Engineering (Nuclear Specialty)
Austin, Texas 78712
(4-year)

University of Texas at Austin
Petroleum Engineering Department
Austin, Texas 78712
(4-year; Graduate)

Utah

Brigham Young University
Chemical Engineering Department (Nuclear Option)
Provo, Utah 84602
(4-year)

Brigham Young University
Mechanical Engineering Department (Nuclear Option)
Provo, Utah 84602
(4-year)

Brigham Young University
Chemical Engineering Department
(Energy and Environment Option)
Provo, Utah 84602
(4-year)

College of Eastern Utah
Division of Applied Sciences (Mining Technology)
451 East Fourth North
Price, Utah 84501
(2-year)

Virginia

Central Virginia Community College
Engineering and Technology Division
Nuclear Technology Program
Wards Road South
P.O. Box 4098
Lynchburg, Virginia 24502
(2-year)

Mountain Empire Community College
Division of Technologies
Mining Technology Program
Big Stone Gap, Virginia 24219
(Certificate; 1-year; 2-year)

Southwest Virginia Community College
Division of Engineering
Mining Technology
P.O. Box SVCC
Richlands, Virginia 24641
(2-year)

Washington

University of Washington
Nuclear Engineering Department
303 Benson Hall
BF-10
Seattle, Washington 98195
(4-year; Graduate)

Washington State University
Department of Chemical and Nuclear Engineering
Pullman, Washington 99163
(Graduate)

West Virginia

Bluefield State College
Engineering Technology Department (Mining Option)
Bluefield, West Virginia 24701
(2-year; 4-year)

Southern West Virginia Community College
Mining Education
Williamson, West Virginia 25661
(2-year)

West Virginia Institute of Technology
Mining Engineering Technology Program
Montgomery, West Virginia 25136
(Certificate; 2-year; 4-year)

West Virginia University
College of Mineral and Energy Resources
Mineral Processing Engineering
Morgantown, West Virginia 26506
(4-year; Graduate)

West Virginia University
College of Mineral and Energy Resources
Petroleum Engineering
Morgantown, West Virginia 26506
(4-year; Graduate)

Wisconsin

University of Wisconsin at Milwaukee
College of Engineering and Applied Science
Engineering & Mathematical Sciences Building
Milwaukee, Wisconsin 53201
(4-year)

Wyoming

Casper College
Division of Technology Trades and Industry
125 College Drive
Casper, Wyoming 82601
(2-year)

Casper College
Division of Technology Trades and Industry (Coal Field Technology; Petroleum Engineering Technology)
125 College Drive
Casper, Wyoming 83601
(2-year)

9. Combined Drinking Water/ Wastewater Programs

Alaska

University of Alaska
Civil Engineering Department
Fairbanks, Alaska 99701
(4-year; Graduate)

Arizona

Arizona State University
Civil Engineering Department
Tempe, Arizona 85281
(4-year; Graduate)

Phoenix College
Technology Department
1202 West Thomas
Phoenix, Arizona 85013
(Certificate)

University of Arizona
Department of Civil Engineering and Engineering Mechanics
Tucson, Arizona 85721
(4-year; Graduate)

Arkansas

University of Arkansas
Civil Engineering Department
Fayetteville, Arkansas 72701
(4-year; Graduate)

California

Butte Community College
Mathematics, Technology and Telecommunications Department
Pentz and Clark Roads
Route 1
Box 183A
Oroville, California 95965
(Certificate)

California State University, Fresno
Civil Engineering Department
Fresno, California 93740
(4-year; Graduate)

California State University at Fullerton
Civil Engineering Mechanics Department
Fullerton, California 92634
(4-year; Graduate)

California State University at Sacramento
Civil Engineering Department
6000 J Street
Sacramento, California 95819
(4-year; Graduate)

Citrus College
Public Services Department
18824 East Foothill Blvd.
Azusa, California 91702
(Certificate)

College of the Canyons
Environmental Control Department
26455 North Rockewell Canyon Road
Valencia, California 91355
(Certificate)

Contra Costa College
Technical and Industrial Division
2600 Mission Bell Drive
San Pablo, California 94806
(Certificate; 2-year)

Fresno City College
Water Utility Science Department
1101 East University Avenue
Fresno, California 93741
(Certificate)

Los Angeles Trade and Technical College
Science and Mathematics Department
400 West Washington Boulevard
Los Angeles, California 90015
(2-year)

Loyola Marymount University
Civil Engineering and Environmental Science Department
Loyola Boulevard at West 80th Street
Los Angeles, California 90045
(4-year; Graduate)

Modesto Junior College
Engineering, Mathematics and Physical Sciences Department
College Avenue
Modesto, California 95350
(2-year)

Orange Coast College
Division of Technology
2701 Fairview Road
Costa Mesa, California 92626
(Certificate; 2-year)

San Diego State University
Civil Engineering Department
San Diego, California 92182
(4-year; Graduate)

Santa Ana College
Water Utility Science Department
17th at Bristol
Santa Ana, California 92706
(2-year)

Sierra College
Special Programs Department
5000 Rocklin Road
Rocklin, California 95677
(No degree)

University of California at Berkeley
Civil Engineering Department
Berkeley, California 94720
(4-year; Graduate)

University of California at Davis
Civil Engineering Department
Davis, California 95616
(4-year)

University of California at Irvine
Mechanical Engineering Department
Irvine, California 92664
(4-year; Graduate)

University of California at Irvine
Civil Engineering Department
Irvine, California 92664
(4-year; Graduate)

University of Southern California
Environmental Engineering Department
Los Angeles, California 90007
(Graduate)

Ventura College
Water Science Department
4667 Telegraph Road
Ventura, California 93003
(Certificate)

Colorado

Colorado State University
Civil Engineering Department
Fort Collins, Colorado 80523
(4-year; Graduate)

Community College of Denver
Division of Service Occupations
12600 West 6th Avenue
Denver, Colorado 80201
(2-year)

Pikes Peak Community College
Division of Science and Math
5675 South Academy Boulevard
Colorado Springs, Colorado 80906
(2-year)

University of Colorado
Department of Civil, Environmental, and Architectural Engineering
Boulder, Colorado 80309
(4-year; Graduate)

Connecticut

University of Connecticut
Civil Engineering Department
Room 334
Fl. Castleman Building
Stoors, Connecticut 06268
(4-year)

Delaware

Delaware Technical and Community College
Civil Engineering Technology Department
Southern Campus
Box 610
Georgetown, Delaware 19947
(2-year)

Florida

Edison Community College
Continuing Education Division
College Parkway
Fort Myers, Florida 33901
(Certificate)

Florida Keys Community College
Resource Development and Planning Department
Stock Island
Key West, Florida 33040
(Certificate)

Florida Technological University
Civil Engineering and Environmental Sciences Department
Orlando, Florida 32816
(Graduate)

Hillsborough Community College
Environmental Science Department
P.O. Box 22127
Tampa, Florida 33622
or
Plant City Campus
1206 North Park Road
Plant City, Florida 33566
(Certificate; 2-year)

Indian River Community College
Municipal Services Division
3209 Virginia Avenue
Fort Pierce, Florida 33450
(Certificate; 2-year)

Miami-Dade Community College
Department of Engineering
South Campus
11011 S.W. 104th Street
Miami, Florida 33176
(2-year)

Palm Beach Junior College
Biology Department
400 Congress Avenue
Lake Worth, Florida 33461
(2-year)

Pasco-Hernando Community College
Vocational/Technical Development Programs
West Campus
7025 State Road 587
New Port Richey, Florida 33552
(Certificate)

Pensacola Junior College
Water and Wastewater Operators Training Program
Route 8
Box 670 G
Pensacola, Florida 32505
(Certificate)

Pinellas Vocational Technical Institute
Water and Wastewater Training Program
6100-154 Avenue North
Clearwater, Florida 33520
(Certificate)

Polk Community College
Water and Wastewater Treatment Program
999 Avenue H, N.E.
Winter Haven, Florida 33880
(Certificate)

University of Florida
Civil Engineering Department
Gainesville, Florida 32611
(4-year; Graduate)

University of Miami
Civil Engineering Department
University Station
Coral Gables, Florida 33124
(4-year; Graduate)

Washington Holmes Area Vocational Technical Center
Public Service Department
Route 4
Box 177A
Graceville, Florida 32440
(Certificate)

Withlocoochee Vocational Technical Center
Water and Wastewater Treatment Program
1607 West Main Street
Inverness, Florida 32650
(Certificate)

Georgia

Georgia Military College
Environmental Health Department
Milledgeville, Georgia 31061
(2-year)

West Georgia College
Georgia Water and Wastewater Institute
Carrollton, Georgia 30117
(Certificate)

Hawaii

University of Hawaii at Manoa
Civil Engineering Department
Honolulu, Hawaii 96822
(4-year)

Idaho

Idaho State University
Vocational-Technical School
Pocatello, Idaho 83209
(Certificate)

University of Idaho
Civil Engineering Department
Moscow, Idaho 83843
(4-year; Graduate)

Illinois

College of Lake County
Construction Technologies Department
19351 West Washington Street
Grayslake, Illinois 60030
(1-year)

Illinois Institute of Technology
Pritzker Department of Environmental Engineering
102 Alumni Memorial Hall
Chicago, Illinois 60616
(4-year; Graduate)

Kishwaukee College
Career Education Department
P.O. Box 888
Malta, Illinois 60150
(Certificate)

Lincoln Trails Community College
Vocational-Technical Education Programs
Route 3
Robinson, Illinois 62454
(2-year)

University of Illinois at Urbana-Champaign
Civil Engineering Department
Urbana, Illinois 61801
(4-year; Graduate)

Indiana

Indiana Vocational Technical College at Gary
Environmental Training Coordination Center
1440 East 35th Avenue
Gary, Indiana 46409
(2-year)

Iowa

Iowa State University
Civil Engineering Department
496 Town Engineering Building
Ames, Iowa 50011
(Graduate)

Kirkwood Community College
Environmental Studies and Pollution Control Department
Linn Hall
Cedar Rapids, Iowa 52406
(1-year)

University of Iowa
Energy Engineering Department
2216 Engineering Building
Iowa City, Iowa 52242
(Graduate)

Kansas

Kansas State University
Civil Engineering Department
Seaton Hall
Manhattan, Kansas 66506
(Graduate)

University of Kansas
Interdisciplinary Program (Water Resources, Engineering and Science)
1039 Learned Hall
Lawrence, Kansas 66045
(Graduate)

Louisiana

Delgado College
Environmental Health Technology Department
615 Park Avenue
New Orleans, Louisiana 70119
(2-year)

Louisiana State University
Civil Engineering Department
Baton Rouge, Louisiana 70803
(4-year; Graduate)

Louisiana Tech University
Civil Engineering Department
P.O. Box 4874
Tech Station
Ruston, Louisiana 71270
(4-year; Graduate)

Tulane University
Civil Engineering Department
New Orleans, Louisiana 70118
(4-year; Graduate)

University of New Orleans
School of Engineering
Lake Front
New Orleans, Louisiana 70122
(4-year)

Maine

Eastern Maine Vocational Technical Institute
Environmental Control Technology Department
354 Hogan Road
Bangor, Maine 04401
(2-year)

University of Maine
Civil Engineering Department
Orono, Maine 04473
(Graduate)

Massachusetts

Bristol Community College
Engineering Department
Fall River, Massachusetts 02720
(2-year)

Central New England College
Engineering Department
768 Main Street
Worcester, Massachusetts 01608
(2-year)

Harvard University
Sanitary Engineering Department
Boston, Massachusetts 02115
(Graduate)

Massachusetts Institute of Technology
Civil Engineering Department
Cambridge, Massachusetts 02139
(4-year; Graduate)

North Shore Community College
Essex Agricultural and Technical Institute
3 Essex Street
Beverly, Massachusetts 01915
(2-year)

Tufts University
Civil Engineering Department
Medford, Massachusetts 02155
(4-year; Graduate)

University of Lowell
Civil Engineering Department
1 University Avenue
Lowell, Massachusetts 01854
(Graduate)

University of Massachusetts at Amherst
Civil Engineering Department
Amherst, Massachusetts 01003
(Graduate)

Wentworth College of Technology
Civil Engineering Technology
550 Huntington Avenue
Boston, Massachusetts 02115
(4-year)

Worcester Polytechnic Institute
Civil Engineering Department
Worcester, Massachusetts 01609
(4-year; Graduate)

Michigan

Bay De Noc Community College
Vocational-Technical Education Department
Escanaba, Michigan 49829
(2-year)

Macomb County Community College
Occupational Program
14500 Twelve Mile Road
South Campus
Warren, Michigan 48089
(Certificate: 2-year)

Michigan Technological University
Civil Engineering Department
Civil-Geology Building
Room 110
Houghton, Michigan 49931
(4-year; Graduate)

Wayne State University
Civil Engineering Department
Detroit, Michigan 48202
(Graduate)

Minnesota

Mankato State University
Biological Sciences Department
Mankato, Minnesota 56001
(2-year)

St. Cloud Area Vocational Technical Institute
Water and Waste Treatment Technology
1540 Northway Drive
St. Cloud, Minnesota 56301
(2-year)

Vermilion Community College
Technical Program
1900 East Camp Street
Ely, Minnesota 55731
(2-year)

Mississippi

Mississippi State University
Civil Engineering Department
Drawer DE
Mississippi State, Mississippi 39762
(4-year; Graduate)

Missouri

University of Missouri at Columbia
Civil Engineering Department
College of Engineering
Columbia, Missouri 65201
(4-year; Graduate)

University of Missouri at Rolla
Civil Engineering Department
Rolla, Missouri 65401
(Graduate)

Water and Wastewater Technical School
Box 370
Neosho, Missouri 64850
(1-year)

Montana

Montana State University
Civil Engineering and Engineering Mechanics Department
Bozeman, Montana 59715
(4-year; Graduate)

Northern Montana College
Environmental Health Technology Department
Havre, Montana 59501
(Certificate; 2-year)

Nebraska

Central Technical Community College
Environmental Technology Department
Box 1024
Hastings, Nebraska 68901
(1-year; 2-year)

University of Nebraska
Civil Engineering Department
Lincoln, Nebraska 68508
(4-year; Graduate)

University of Nebraska
Civil Engineering, Water Resources
Engineering Program
310 Ag Hall
Lincoln, Nebraska 68508
(Graduate)

Nevada

University of Nevada at Reno
Civil Engineering Department
Reno, Nevada 89557
(4-year; Graduate)

New Hampshire

New Hampshire Vocational Technical College
Natural Resources Management Department
Milan Road
Berlin, New Hampshire 03750
(2-year)

University of New Hampshire
Civil Engineering
College of Engineering and Physical Sciences
Durham, New Hampshire 03824
(4-year; Graduate)

New Jersey

County College of Morris
Chemistry/Chemical Technology Department
Route 10 and Center Grove Road
Randolph Township, New Jersey 07801
(2-year)

Princeton University
Department of Civil Engineering
Princeton, New Jersey 08540
(Graduate)

Rutgers, The State University of New Jersey
Department of Civil and Environmental
Engineering
P.O. Box 909
Piscataway, New Jersey 08854
(Graduate)

Rutgers, The State University of New Jersey
Department of Civil and Environmental
Engineering
B245 Engineering Building
Busch Campus
New Brunswick, New Jersey 08903
(4-year; Graduate)

Salem Community College
Chemistry Department
P.O. Box 551
Penn Grove, New Jersey 08069
(2-year)

Stevens Institute of Technology
Mechanical Engineering Department
Castle Point Station
Hoboken, New Jersey 07030
(Certificate)

New Mexico

New Mexico State University
Civil Engineering Department
Las Cruces, New Mexico 88001
(4-year)

New Mexico State University
Dona Ana County Occupational Education
Branch
Las Cruces, New Mexico 88001
(2-year)

New York

City University of New York
City College
Evening Division
School of General Studies
Civil Engineering
Convent Avenue at 138th Street
New York City, New York 10031
(4-year)

City University of New York
City College
Civil Engineering Department
Convent Avenue at 138th Street
New York City, New York 10031
(4-year)

The Cooper Union
Civil Engineering Department
New York City, New York 10003
(4-year; Graduate)

Erie County Community College
Chemical Technology Program
North Campus
Main and Youngs Road
Williamsville, New York 14209
(2-year)

Herkimer County Community College
Mathematics Science Division
Reservoir Road
Herkimer, New York 13350
(1-year)

Manhattan College
Civil Engineering Department
Bronx, New York 10471
(4-year; Graduate)

Mohawk Valley Community College
Mathematics and Science Department
1101 Sherman Drive
Utica, New York 13501
(2-year)

Monroe Community College (State University
of New York)
Division of Engineering Technologies
10009 Henrietta Road
Rochester, New York 14623
(2-year)

Rochester Institute of Technology
Civil Engineering Technology
One Lomb Drive
Rochester, New York 14623
(4-year)

State University of New York
Agricultural and Technical College at
Cobleskill
Division of General Education
Cobleskill, New York 12043
(2-year)

State University of New York
Agricultural and Technical College at Delhi
Division of Engineering Technologies
Department of Civil Technology
Delhi, New York 13753
(2-year)

State University of New York
Agricultural and Technical College at
Morrisville
Engineering Technologies Division
Morrisville, New York 13408
(2-year)

State University of New York at Stony Brook
College of Engineering and Applied Science
Department of Mechanical Engineering
Stony Brook, New York 11794
(Graduate)

Sullivan County Community College
Civil Technology Department
Loch Sheldrake, New York 12759
(2-year)

Tomkins Cortland Community College
Environmental Science (Public Health
Technology)
Dryden, New York 13053
(1-year; 2-year)

North Carolina

North Carolina State University
Interdepartmental Program (Water Resources
Research Institute) Raleigh, North Carolina
27607
(Graduate)

University of North Carolina at Chapel Hill
Environmental Sciences and Engineering
School of Public Health
Chapel Hill, North Carolina 27514
(Graduate)

North Dakota

North Dakota State University
Civil Engineering Department
Fargo, North Dakota 58102
(4-year; Graduate)

University of North Dakota
Civil Engineering Department
Grand Forks, North Dakota 58202
(4-year; Graduate)

Ohio

Muskingum Area Technical College
Division of Engineering and Science
1555 Newark Road
Zanesville, Ohio 43701
(2-year)

Ohio State University
Civil Engineering Department
470 Hitchcock Hall
Columbus, Ohio 43210
(4-year; Graduate)

Oklahoma

Connors State College
Social Sciences Division
Water Way Law Enforcement
Warner, Oklahoma 74469
(2-year)

Oklahoma State University
Civil Engineering Department
Stillwater, Oklahoma 74074
(4-year; Graduate)

Oregon

Lane Community College
Department of Science
4000 East 30th Avenue
Eugene, Oregon 97405
(2-year)

Linn-Benton Community College
Science and Technology Division
6500 S.W. Pacific Boulevard
Albany, Oregon 97321
(Certificate; 1-year; 2-year)

Oregon Institute of Technology
Division of Allied Health Technologies
Oretech Post Office
Klamath Falls, Oregon 97601
(2-year)

Oregon State University
Civil Engineering Department
Corvallis, Oregon 97331
(4-year; Graduate)

Pennsylvania

Carnegie-Mellon University
Carnegie Institute of Technology
Civil Engineering Department
Pittsburgh, Pennsylvania 15213
(Graduate)

Community College of Allegheny County
Department of Engineering
Environmental Technology
Boyce Campus
595 Beatly Road
Monroeville, Pennsylvania 15146
(2-year)

Harrisburg Area Community College
Division of Mathematics,
Physical Sciences and Engineering
3300 Cameron St. Road
Harrisburg, Pennsylvania 17110
(Certificate; 2-year)

Lehigh University
Civil Engineering Department
Fritz Lab, No. 13
Bethlehem, Pennsylvania 18015
(4-year; Graduate)

Pennsylvania State University
Civil Engineering Technology Program
Capitol Campus
Upper Division and Graduate Center
Middletown, Pennsylvania 17057
(4-year)

Rhode Island

University of Rhode Island
Department of Geography and Marine Affairs
Kingston, Rhode Island 02881
(Graduate)

University of Rhode Island
Ocean Engineering Department
Kingston, Rhode Island 02881
(Graduate)

South Carolina

Clemson University
Environmental Systems Engineering
Clemson, South Carolina 29631
(Graduate)

Clemson University
Civil Engineering Department
Clemson, South Carolina 29631
(Graduate)

Florence-Darlington Technical College
Division of Engineering Technology
P.O. Drawer 8000
Florence, South Carolina 29501
(2-year)

South Dakota

South Dakota School of Mines and Technology
Civil Engineering Department
Rapid City, South Dakota 57701
(4-year; Graduate)

South Dakota State University
Civil Engineering Department
Brookings, South Dakota 57006
(4-year; Graduate)

Tennessee

Tennessee Operator's Training School
Water and Wastewater Treatment Program
Blanton Drive
Route 4
Murfreesboro, Tennessee 37130
(Certificate)

Tennessee State University
Civil Engineering Department
3500 Centennial Boulevard
Nashville, Tennessee 37203
(4-year)

Tennessee Technological University
Civil Engineering Department
Cookeville, Tennessee 38501
(4-year; Graduate)

University of Tennessee
Civil Engineering Department
Knoxville, Tennessee 37916
(4-year; Graduate)

Vanderbilt University
Environmental Engineering and Policy Management
Nashville, Tennessee 37240
(4-year; Graduate)

Texas

Lamar University
Civil Engineering Department
Beaumont, Texas 77710
(4-year)

Rice University
Environmental Science and Engineering Department
P.O. Box 1892
Houston, Texas 77001
(4-year; Graduate)

Texas Engineering Extension Service
Texas A&M University System
Water/Wastewater Training Division
F.E. Drawer K
Texas A&M
College Station, Texas 77843
(Certificate)

Texas State Technical Institute
Technical Career Fields Department
Water/Wastewater Technology Program
Waco, Texas 76705
(Certificate; 2-year)

Texas Tech University
Civil Engineering Department
Lubbock, Texas 79409
(4-year; Graduate)

University of Houston
Civil Engineering Department
4800 Calhoun
Houston, Texas 77004
(4-year; Graduate)

University of Texas at Arlington
Civil Engineering Department
Arlington, Texas 76010
(4-year; Graduate)

University of Texas at Austin
Civil Engineering Department
Austin, Texas 78712
(4-year; Graduate)

Utah

Brigham Young University
Civil Engineering Department
Provo, Utah 84602
(Graduate)

Utah State University
Civil and Environmental Engineering Department
Logan, Utah 84322
(4-year; Graduate)

Vermont

Norwich University/Vermont College
Department of Engineering and Technology
Northfield, Vermont 05663
(4-year)

Virgin Islands

College of the Virgin Islands
Science and Mathematics Division
Water Resources Research Center
Carribean Research Institute, St. Thomas Campus
St. Thomas, U.S. Virgin Islands 00801
(4-year)

Virginia

J. Sargeant Reynolds Community College
Division of Engineering and Engineering Technology
Richmond, Virginia 23241
(Certificate)

Virginia Polytechnic Institute and State University
Civil Engineering Department
Blacksburg, Virginia 24061
(4-year; Graduate)

Wytheville Community College
Division of Engineering Technologies/Mathematics
1000 E. Main Street
Wytheville, Virginia 24382
(1-year; 2-year)

Washington

Washington State University
Civil and Environmental Engineering Department
Pullman, Washington 99164
(4-year; Graduate)

Wisconsin

Marquette University
Civil Engineering Department
1515 West Wisconsin Avenue
Milwaukee, Wisconsin 53233
(4-year; Graduate)

Milwaukee Area Technical College
Service and Health Occupations Division
1015 North Sixth Street
Milwaukee, Wisconsin 53203
(2-year)

Moraine Park Technical Institute
Agri-Biotechnology Division
235 North National Avenue
Fond du Lac, Wisconsin 54935
(2-year)

University of Wisconsin at Madison
Water Resources Center
1975 Willow Drive
Madison, Wisconsin 53706
(Graduate)

Wyoming
Casper College
Division of Life Sciences
125 College Drive
Casper, Wyoming 82601
(2-year)

10. Environmental Science/Health Programs

Alabama
Alabama A & M University
Department of Natural Resource and Environmental Science
Normal, Alabama 35762
(4-year)

Auburn University
Interdepartmental Program
Schools of Agriculture Education, Engineering, Home Economics and Pharmacy Enrivonmental Health Program
Auburn, Alabama 36830
(4-year)

Troy State University
Biological Sciences Department
Environmental Science Program
Troy, Alabama 36081

University of Alabama in Birmingham
School of Natural Sciences and Mathematics
University Station
Birmingham, Alabama 35294
(4-year)

University of Alabama in Huntsville
Center for Environmental Studies
P.O. Box 1247
Huntsville, Alabama 35807
(4-year; Graduate)

Arizona
Grand Canyon College
Natural Sciences and Mathematics Department
3300 West Camelback Road
Phoenix, Arizona 85017
(4-year)

Northern Arizona University
Inderdepartmental Environmental Science Program
P.O. Box 4103
Flagstaff, Arizona 86011
(4-year)

Arkansas
University of Arkansas
Interdepartmental Program in Environmental Science
Fayetteville, Arkansas 72701
(4-year)

University of Arkansas
Health Sciences Department
33rd and University
Little Rock, Arkansas 72204
(4-year)

California
California State College at Stanislaus
Interdepartmental Program in Environmental Sciences
800 Monte Vista Avenue
Turlock, California 95380
(4-year)

California State University at Los Angeles
Microbiology and Public Health Department
5151 State University Drive
Los Angeles, California 90032
(4-year)

California State University at Los Angeles
Biology Department
5151 State University Drive
Los Angeles, California 90032
(4-year)

California State University at Northridge
Health Science Department
18111 Nordhoff Street
Northridge, California 91330
(4-year; Graduate)

California State University at Sacramento
Biology Department
6000 J Street
Sacramento, California 95819
(4-year)

Fullerton College
Life Science Department
321 E. Chapman Avenue
Fullerton, California 92634
(2-year)

Merrit College
Division of Science/Mathematics
12500 Campus Drive
Oakland, California 94619
(2-year)

San Diego State University
Microbiology Department
San Diego, California 92182
(4-year)

San Jose State University
Biological Sciences Department
San Jose, California 95192
(4-year)

University of California at Berkeley
Biomedical and Environmental Health Sciences Department
Berkeley, California 94720
(Graduate)

University of California at Los Angeles
Interdepartmental Program in Environmental Science and Engineering
405 Hilgard Avenue
Los Angeles, California 90024
(Graduate)

University of California at Riverside
Soil and Environmental Sciences Department
Riverside, California 92502
(4-year)

Victor Valley College
Environmental Science Department
18422 Bear Valley Road
P.O. Drawer 00
Victorville, California 92392
(2-year)

West Coast University
Environmental Science Department
440 Shatto Place
Los Angeles, California 90020
(Graduate)

Colorado
Adams State College
Division of Scientific and Technological Studies
Alamosa, Colorado 81102
(4-year)

Colorado State University
Microbiology Department
Fort Collins, Colorado 80523
(4-year; Graduate)

Connecticut
Eastern Connecticut State College
Interdisciplinary Program in Environmental Earth Science
Willimantic, Connecticut 06226
(4-year)

Eastern Connecticut State College
Biology Department
Willimantic, Connecticut 06226
(4-year)

Hartford Graduate Center
Environmental Science and Technology Department
275 Windsor Street
Hartford, Connecticut 06120
(Graduate)

Middlesex Community College
Environmental Science Program
100 Training Hill Road
Middletown, Connecticut 06457
(2-year)

Northwestern Connecticut Community College
Engineering Technology Department
Park Place
Winsted, Connecticut 06098
(2-year)

Quinnipiac College
School of Allied Health and Natural Sciences
Hamden, Connecticut 06518
(4-year)

Wesleyan University
Earth and Environmental Sciences Department
Middletown, Connecticut 06457
(4-year; Graduate)

Western Connecticut State College
Biological and Environmental Sciences Department
181 White Street
Danbury, Connecticut 06810
(4-year)

Western Connecticut State College
Earth, Space and Environmental Sciences Department
181 White Street
Danbury, Connecticut 06810
(4-year; Graduate)

Yale University
Epidemiology and Public Health Department
60 College Street
New Haven, Connecticut 06510
(Graduate)

District of Columbia

George Washington University
College of General Studies
Washington, D.C. 20052
(Graduate)

The University of the District of Columbia
Environmental Science Department
4200 Connecticut Avenue, N.W.
Washington, D.C. 20008
(2-year)

Florida

Florida Institute of Technology
Environmental Science Department
Melbourne, Florida 32901
(4-year; Graduate)

Heed University
Ocean and Environment Affairs Program
P.O. Box 311
Hollywood, Florida 33020
(Graduate)

Santa Fe Community College
Technical Education Department
P.O. Box 1530
3000 N.W. 83rd Street
Gainesville, Florida 32602
(2-year)

University of Miami
Physics Department
University Station
Coral Gables, Florida 33124
(4-year)

Georgia

Georgia College
Biology Department
Milledgeville, Georgia 31061
(4-year)

Savannah State College
Biology Department
Savannah, Georgia 31404
(4-year)

University of Georgia
College of Agriculture
Environmental Health Program
Athens, Georgia 30602
(4-year)

Hawaii

The University of Hawaii at Manoa
Public Health Sciences Department
Honolulu, Hawaii 96822
(Graduate)

Idaho

Boise State University
Community and Environmental Health Department
1910 College Boulevard
Boise, Idaho 83725
(Graduate)

Illinois

College of Du Page
Sigma-Environmental Health
Lambert Road and 22nd Street
Glen Ellyn, Illinois 60137
(2-year)

Governors State University
College of Environmental and Applied Sciences
Park Forest South, Illinois 60466
(4-year; Graduate)

Illinois State University
Center for Allied Health Professions
Normal, Illinois 61767
(4-year)

University of Illinois at Chicago
School of Public Health, Medical Center at Chicago
Box 6998
Chicago, Illinois 60680
(Graduate)

Indiana

Indiana University
School of Public and Environmental Affairs
Poplars 438
Bloomington, Indiana 47401
(Certificate; 2-year; 4-year; Graduate)

Purdue University
School of Agriculture
Natural Resources and Environmental Science Program
West Lafayette, Indiana 47907
(Graduate)

Purdue University
School of Science
Environmental Sciences Option
West Lafayette, Indiana 47907
(4-year)

Iowa

Kirkwood Community College
Department of Environmental Studies and Pollution Control
Linn Hall
Cedar Rapids, Iowa 52406
(1-year; 2-year)

Kansas

McPherson College
Interdisciplinary Program in Environmental Science
McPherson, Kansas 67460
(4-year)

University of Kansas
Civil Engineering Department
4002 Learned Hall
Lawrence, Kansas 66043
(Graduate)

Kentucky

Eastern Kentucky University
School of Public Health
Richmond, Kentucky 40475
(4-year; Graduate)

Western Kentucky University
Environmental Technology Department
Bowling Green, Kentucky 42101
(4-year)

Louisiana

Delgado College
Environmental Health Technology Department
615 Park Avenue
New Orleans, Louisiana 70119
(2-year)

McNeese State University
Microbiology Department
Lake Charles, Louisiana 70609
(4-year; Graduate)

Maine

Colby College
Biology Department
Waterville, Maine 04901
(4-year)

College of the Atlantic
Physical and Biological Sciences Department
Bar Harbor, Maine 04609
(4-year)

Nasson College
Division of Science and Mathematics
Springvale, Maine 04083
(4-year)

Unity College
Center of Environmental Science
Quaker Hill
Unity, Maine 04988
(2-year; 4-year)

Maryland

Bay College of Maryland
Department of Environmental Science
Howard and Centre Streets
Baltimore, Maryland 21201
(2-year)

Community College of Baltimore
Division of Engineering, Marine and Maritime Technologies
2901 Liberty Heights Avenue
Baltimore, Maryland 21215
(Certificate; 2-year)

University of Maryland-Eastern Shore
Interdisciplinary Program in Environmental Science
Princess Anne, Maryland 21853
(4-year)

Massachusetts

Anna Maria College
Biological Sciences Department
Paxton, Massachusetts 01612
(4-year)

Berkshire Community College
Environmental Science Department
West Street
Pittsfield, Massachusetts 01201
(2-year)

Harvard School of Public Health
Environmental Health Sciences Department
665 Huntington Avenue
Boston, Massachusetts 02115
(Graduate)

Harvard University
Division of Applied Sciences
Environmental Engineering
Environmental Systems Planning
Pierce Hall 212
Cambridge, Massachusetts 02138
(4-year; Graduate)

Holyoke Community College
Division of Health Related Programs
303 Homestead Ave
Holyoke, Massachusetts 01040
(2-year)

Merrimack College
Department of Biology
North Andover, Massachusetts 01845
(4-year)

Merrimack College
Department of Chemistry
North Andover, Massachusetts 01845
(Graduate)

University of Massachusetts at Amherst
Division of Public Health
Amherst, Massachusetts 01002
(4-year; Graduate)

University of Massachusetts at Amherst
Environmental Sciences Department
Amherst, Massachusetts 01002
(Graduate)

Worcester Polytechnic Institute
Environmental Studies
Division of Interdisciplinary Affairs
Worcester, Massachusetts 01609
(4-year)

Michigan

Ferris State College
Environmental Quality Programs
Big Rapids, Michigan 49307
(2-year; 4-year)

Grand Valley State College
College of Arts and Sciences
Allendale, Michigan 49401
(4-year)

Lake Superior State College
Interdepartmental Program in Environmental Science
Sault Ste. Marie, Michigan 49783
(4-year)

Oakland University
Interdisciplinary Program in Environmental Health
Rochester, Michigan 48063
(4-year)

Minnesota

Saint Mary's College
Biology Department
Winona, Minnesota 55987
(4-year; Graduate)

University of Minnesota
School of Public Health
1160 Mayo
Minneapolis, Minnesota 55455
(4-year)

Winona State University
Biology Department
Winona, Minnesota 55987
(4-year)

Mississippi

Hinds Junior College
Chemistry Department
Raymond Campus
Raymond, Mississippi 39154
(2-year)

Mississippi State University
College of Arts and Sciences
General Science
Drawer AS
Mississippi State, Mississippi 39762
(4-year)

Mississippi State University
College of Agriculture
Dairy Science Department
Drawer AG
Mississippi State, Mississippi 39762
(4-year)

Mississippi Valley State University
Biology Department
Itta Bena, Mississippi 38941
(4-year)

University of Mississippi
Department of Geology and Geological Engineering
University, Mississippi 38677
(4-year)

University of Southern Mississippi
Department of Environmental Technology and Industrial Hygiene
Hattiesburg, Mississippi 39401
(4-year; Graduate)

Missouri

Crowder College
Vocational Technical Department
Environmental Health Program
Neosho, Missouri 64850
(2-year)

Missouri South State College
Department of Environmental Health/Biology
308A Science Building
Newman and Duquesne Roads
Joplin, Missouri 64801
(2-year; 4-year)

Northeast Missouri State University
Division of Science
Kirksville, Missouri 63501
(4-year)

New Jersey

Burlington County College
Science, Math and Technology Department
Pemberton-Browns Mills Road
Pemberton, New Jersey 08068
(2-year)

Fairleigh Dickinson University
College of Science and Engineering
1000 River Road
Teaneck, New Jersey 17666
(4-year)

Middlesex County College
Chemistry Department
Environmental Health Science Technology Program
Edison, New Jersey 08817
(2-year)

Ramapo College of New Jersey
School of Theoretical and Applied Science
P.O. Box 542
Mahwah, New Jersey 07430
(4-year)

Rutgers, The State University of New Jersey
Environmental Science Program
101 Georges Road Labs
Cook Campus
New Brunswick, New Jersey 08903
(Graduate)

Union College
Engineering Department
1033 Springfield Avenue
Cranford, New Jersey 07016
(2-year)

New Mexico

Eastern New Mexico University
Department of Biological Sciences
Portales, New Mexico 88130
(4-year)

New Mexico Highlands University
Department of Biology, Environmental Health and Earth Science
Las Vegas, New Mexico 87701
(2-year)

New Mexico Institute of Mining and Technology
Department of Physics
Socorro, New Mexico 87801
(4-year)

New York

Adelphi University
Department of Biology and Earth Science
Marine and Environmental Sciences Program
Garden City, New York 11530
(4-year)

City University of New York
College of Staten Island
Environmental Health Science Program
Saint George Campus
130 Stuyvesant Place
Staten Island, New York 10301
(No degree; 2-year; 4-year)

City University of New York
Hunter College
School of Health Sciences
105 East 106th Street
New York, New York 10029
(4-year; Graduate)

City University of New York
Queens College
Department of Earth and Environmental Sciences
Division of Mathematics and the Natural Sciences
65-30 Kissena Boulevard
Flushing, New York 11367
(4-year; Graduate)

City University of New York
Queensboro Community College
Environmental Health Program
56th & Springfield Avenue
New York, New York 11364
(2-year)

City University of New York
Sunnyside Campus
Environmental Science Program
715 Ocean Terrace
Staten Island, New York 10301
(Graduate)

Daemen College
Department of Natural and Health Sciences
4380 Main Street
Amherst, New York 14226
(No degree)

Elmira College
Biology Department
Park Place
Elmira, New York 14901
(4-year)

Hudson Valley Community College
Environmental Technology Department
Vandenburgh Avenue
Troy, New York 12180
(2-year)

Long Island University
Environmental Science Department
C.W. Post Center
Greenvale, New York 11548
(4-year)

Long Island University
Natural Science Department
Southhampton Center
Southhampton, New York 11968
(4-year)

Marist College
Interdisciplinary Program in Environmental
Science
Poughkeepsie, New York 12061
(4-year)

New York University
Institute of Environmental Medicine
70 Washington Square South
New York, New York 10012
(Graduate)

New York University
Environmental Health Sciences Department
Washington Square Center
New York, New York 10003
(Graduate)

Pratt Institute
School of Liberal Arts and Sciences
Environmental Sciences Program
215 Ryeison Street
Brooklyn, New York 11205
(4-year)

State University of New York at Delhi
Agricultural and Technical College
Dethi, New York 13753
(2-year)

State University of New York at Oswego
Department of Chemistry
Oswego, New York 13126
(4-year)

State University of New York at Plattsburgh
Environmental Science Program
Miner Center
Chazy, New York 12921
(4-year)

State University of New York at Purchase
College of Letters and Sciences
Division of Natural Sciences
Purchase, New York 10577
(4-year)

State University of New York at Syracuse
College of Environmental Science and Forestry
Syracuse, New York 13210
(Graduate)

Wagner College
Department of Bacteriology and Health
Sciences
Staten Island, New York 10301
(4-year)

Wagner College
Interdisciplinary Program in Environmental
Science
Staten Island, New York 10301
(4-year)

Westchester Community College
Mathematics and Science Program
75 Grasslands Road
Valhalla, New York 10595
(2-year)

North Carolina

Belmont Abbey College
Interdepartmental Program in Environmental
Science
Belmont, North Carolina 28012
(4-year)

Duke University
School of Forestry and Environmental Studies
Durham, North Carolina 27706
(Graduate)

East Carolina University
Department of Environmental Health
310 Belk
Greenville, North Carolina 27834
(4-year; Graduate)

Elizabeth City State University
Department of Geosciences
Elizabeth City, North Carolina 27909
(4-year)

Martin Community College
Technical Education Department
Kehukee Park Road
Williamston, North Carolina 27892
(2-year)

North Carolina Agricultural and Technical
State University
Department of Plant Science and Technology
312 North Dudley Street
Greensboro, North Carolina 27411
(4-year)

North Carolina Wesleyan College
Interdepartmental Program in Environmental
Science
Rocky Mount, North Carolina 27801
(4-year)

Saint Augustine's College
Department of Chemistry
Raleigh, North Carolina 27611
(4-year)

Southwestern Technical Institute
Human Services Department
P.O. Box 95
Sylva, North Carolina 28779
(2-year)

University of North Carolina at Charlotte
Geography and Earth Sciences Department
UNCC Station
Charlotte, North Carolina 28223
(4-year)

University of North Carolina at Greensboro
Geography Department
100 Spring Garden Street
Greensboro, North Carolina 27412
(4-year)

Wilkes Community College
Food and Environmental Science Technologies
Department
Collegiate Drive
Wilkesboro, North Carolina 28697
(2-year)

Winston-Salem State University
Interdepartmental Program in Environmental
Science
Winston-Salem, North Carolina 27102
(4-year)

North Dakota

Minot State College
Interdepartmental Program in Environmental
Science
Minot, North Dakota 58701
(4-year)

North Dakota State School of Science
Technical Division
Environmental Science Technology Program
Wahpeton, North Dakota 58075
(2-year)

Ohio

Hocking Technical College
Natural Science Department
Route 1
Nelsonville, Ohio 45764
(2-year)

Miami University
Interdepartmental Program in Environmental
Sciences
Taylor Road
Miami, Ohio 45056
(Graduate)

Ohio University
College of Arts and Sciences
Athens, Ohio 45701
(4-year)

University of Cincinnati
Environmental Health Department
Room 36
Kettering Laboratory
Cincinnati, Ohio 45267
(Graduate)

University of Cincinnati
Medical Center
Environmental Health Department
231 Bethesda Avenue
Cincinnati, Ohio 45267
(Graduate)

University of Cincinnati
Raymond Walters College
Biology Department
9555 Plainfield Road
Cincinnati, Ohio 45236
([illegible]-year)

Wright State University
College of Science and Engineering
Dayton, Ohio 45431
(4-year)

Oklahoma

Claremore Junior College
Occupational-Technical Programs in
Environmental Science
Claremore, Oklahoma 74017
(2-year)

Connors State College
Natural Science Department
Warner, Oklahoma 74469
(2-year)

East Central Oklahoma State University
School of Environmental Science
Ada, Oklahoma 74820
(4-year)

Oklahoma State University
Civil Technology Department
Environmental Health Program
Stillwater, Oklahoma 74074
(2-year)

Oklahoma State University
Interdepartmental Program in Environmental
Science
Stillwater, Oklahoma 74074
(Graduate)

Oklahoma State University
Oklahoma City Technical Institute
Civil Technology Department
900 North Portland
Oklahoma City, Oklahoma 73107
(2-year)

Tulsa Junior College
Scientific and Medical Services Division
Tenth and Boston
Tulsa, Oklahoma 74119
(2-year)

University of Oklahoma
Civil Engineering and Environmental Science Department
202 West Boyd Street
Norman, Oklahoma 73069
(4-year; Graduate)

Oregon

Clatsop Community College
College Transfer Curricula
Environmental Health Program
Astoria, Oregon 97103
(1-year)

Oregon State University
Department of Health
Corvallis, Oregon 97331
(4-year)

Portland State University
Engineering and Applied Science Department
P.O. Box 751
Portland, Oregon 97207
(4-year)

Portland State University
Department of Environmental Sciences and Resources
P.O. Box 751
Portland, Oregon 97207
(Graduate)

Pennsylvania

Drexel University
College of Science
Environmental Science Department
Philadelphia, Pennsylvania 19104
(Graduate)

Juniata College
Department of Biology
Huntingdon, Pennsylvania 16652
(4-year)

Kutztown State College
Environmental Science Program
Kutztown, Pennsylvania 19530
(4-year)

Lehigh University
Interdepartmental Program in Environmental Science and Resource Management
Bethlehem, Pennsylvania 18015
(4-year)

Muhlenberg College
Natural Science and Mathematics Department
Environmental Science Program
24th and Chew Streets
Allentown, Pennsylvania 18104
(4-year)

Saint Francis College of Pennsylvania
Biology Department
Loretto, Pennsylvania 15940
(4-year)

Slippery Rock State College
School of Natural Sciences and Mathematics
Vincent Science Hall No. 117C
Slippery Rock, Pennsylvania 16057
(4-year)

University of Pittsburgh
Department of Industrial Environmental Health Sciences
Graduate School of Public Health
Pittsburgh, Pennsylvania 15261
(Graduate)

Wilkes College
Environmental Sciences Program
Wilkes-Barre, Pennsylvania 18703
(4-year)

Puerto Rico

University of Puerto Rico
Medical Science Campus
Department of Environmental Health
Rio Piedras, Puerto Rico 00936
(Graduate)

Rhode Island

University of Rhode Island
Colleges of Arts and Sciences, Engineering, Pharmacy, and Resource Development
Kingston, Rhode Island 02881
(Graduate)

South Carolina

Clemson University
Interdepartmental Program in Environmental Science
Clemson, South Carolina 29631
(4-year; Graduate)

South Dakota

Northern State College
Interdepartmental Program in Environmental Science
Aberdeen, South Dakota 57401
(4-year)

Tennessee

Austin Peay State University
Biology Department
Clarksville, Tennessee 37040
(4-year)

East Tennessee State University
Department of Environmental Health
Johnson City, Tennessee 37601
(4-year; Graduate)

Middle Tennessee State University
Interdepartmental School of Basic and Applied Sciences
Environmental Science and Technology Program
Murfreesboro, Tennessee 37132
(4-year)

Texas

Lamar University
Department of Chemistry
Beaumont, Texas 77710
(4-year; Graduate)

Sam Houston University
Life Sciences Department
Huntsville, Texas 77340
(4-year)

Texas Christian University
Add Ran College of Arts and Sciences
Fort Worth, Texas 76129
(4-year; Graduate)

University of Texas at Houston
Community Health Sciences
Health Science Center at Houston
School of Public Health
Box 20186
Houston, Texas 77025
(Graduate)

Vermont

Lyndon State College
Natural Sciences Division
Lydonville, Vermont 05851
(4-year)

Saint Michael's College
Department of Chemistry and Biology
Winooski Park, Vermont 05404
(4-year)

University of Vermont
College of Medicine
Department of Epidemiology and Environmental Health
Burlington, Vermont 05401
(4-year)

Virginia

Blue Ridge Community College
Environmental Science Program
Box 80
Weyer's Cave, Virginia 24486
(No degree)

Christopher Newport College
Department of Biology and Environmental Science
P.O. Box 6070
Newport News, Virginia 23606
(4-year)

Longwood College
Natural Science Department
Farmville, Virginia 23901
(4-year)

Northern Virginia Community College
Woodbridge Campus
Environmental and Natural Science Division
15200 Smoketown Road
Woodbridge, Virginia 22191
(Certificate)

Southside Virginia Community College
Christianna Campus
Division of Technologies
Alberta, Virginia 23821
(No degree)

Southside Virginia Community College
John H. Daniel Campus
Division of Technologies
Keysville, Virginia 23947
(No degree)

University of Virginia
College of Arts and Sciences
Department of Environmental Sciences
Charlottesville, Virginia 22903
(4-year; Graduate)

University of Virginia
Environmental Sciences Department
Charlottesville, Virginia 22903
(Graduate)

Virginia Polytechnic Institute
Department of Engineering
Blacksburg, Virginia 24061
(Graduate)

Washington

Washington State University
Interdepartmental Program in Environmental Science
(Colleges of Engineering, Sciences and Arts, and Agriculture)
Pullman, Washington 99163
(4-year)

Washington State University
Environmental Science Department
Pullman, Washington 99163
(Graduate)

Western Washington University
Huxley College of Environmental Studies
516 High Street
Bellingham, Washington 98225
(4-year)

West Virginia

Davis and Elkins College
Earth and Environmental Sciences Program
Elkins, West Virginia 26241
(4-year)

West Virginia Northern Community College
Department of Occupational Safety and Environmental Hygiene
No. 1 College Square
Wheeling, West Virginia 26003
(Certificate; 2-year)

Wisconsin

Marian College of Fond du Lac
Department of Mathematics and Natural Science
P.O. Box 1337
45 South National Avenue
Fond du Lac, Wisconsin 54935
(4-year)

Milwaukee Area Technical College
Service and Health Occupations Division
1015 North Sixth Street
Milwaukee, Wisconsin 53203
(2-year)

University of Wisconsin at Eau Claire
Division of Allied Health Professions
Library 2048
Eau Claire, Wisconsin 54701
(4-year)

Wyoming

Laramie County Community College
Division of Life, Health and Physical Science
Environmental Health Technology Program
1400 East College Drive
Cheyenne, Wyoming 82001
(2-year)

11. Environmental Engineering/Technology Programs

Alabama

Auburn University
Civil Engineering Department
Auburn, Alabama 36830
(Graduate)

University of Alabama
Civil Engineering Department
University, Alabama 35486
(4-year; Graduate)

University of Alabama
Department of Chemical and Metallurgical Engineering
University, Alabama 35486
(4-year; Graduate)

University of South Alabama
Civil Engineering Department
307 University Boulevard
Mobile, Alabama 36688
(4-year)

California

California Institute of Technology
Interdisciplinary Program in Environmental Engineering Science
1201 East California Boulevard
Pasadena, California 91125
(4-year; Graduate)

California Institute of Technology
Department of Chemical Engineering and Environmental Health Engineering
1201 East California Boulevard
Pasadena, California 91125
(4-year)

California Polytechnic State University
Environmental Engineering Department
San Luis Obispo, California 93407
(4-year)

Canada College
Life Sciences Department
4200 Farm Hill Boulevard
Redwood City, California 94061
(2-year)

Humboldt State University
Engineering Department
Arcata, California 95521
(4-year)

University of California at Berkeley
Civil Engineering Department
Berkeley, California 94720
(Graduate)

University of California at Davis
Department of Mechanical Engineering
Davis, California 95616
(4-year; Graduate)

Colorado

Trinidad State Junior College
Department of Civil Environmental Technology
Trinidad, Colorado 81082
(2-year)

Connecticut

Norwalk State Technical College
Chemistry Department
181 Richards Avenue
Norwalk, Connecticut 06854
(2-year)

University of Connecticut
School of Engineering
Environmental Engineering Program
Box UGC
Storrs, Connecticut 06268
(Graduate)

University of Hartford
College of Engineering
200 Bloomfield Avenue
West Hartford, Connecticut 06117
(4-year)

Delaware

Delaware Technical and Community College
Applied Sciences Department
P.O. Box 897
Denney's Road and U.S. Route 13
Dover, Delaware 19901
(2-year)

University of Delaware
Department of Civil and Mechanical Engineering
Newark, Delaware 19711
(Graduate)

District of Columbia

Catholic University of America
Civil Engineering Department
Washington, D.C. 20064
(4-year; Graduate)

George Washington University
School of Engineering and Applied Science
Washington, D.C. 20052
(4-year)

Howard University
Civil Engineering Department
School of Engineering
Washington, D.C. 20059
(4-year; Graduate)

Florida

Brevard Community College
Occupational Education Program
Clearlake Road
Cocoa, Florida 32922
(2-year)

Florida Institute of Technology
Department of Natural Science and Environmental Technology
Jensen Beach, Florida 33457
(2-year; 4-year)

Florida Institute of Technology
Environmental Engineering Department
Melbourne, Florida 32901
(4-year; Graduate)

Florida International University
Engineering Technology Department
Tamiami Trail
Miami, Florida 33199
(4-year)

Florida Technological University
Engineering Technology Department
Orlando, Florida 32816
(4-year)

Manatee Junior College
Technology Department
P.O. Box 1849
Bradenton, Florida 33506
(2-year)

Pasco-Hernando Community College
Environmental Pollution Control Technology Program
2401 State Highway 41 North
Dade City, Florida 33525
(2-year)

University of Florida
College of Engineering
Environmental Engineering Sciences Department
Gainesville, Florida 32611
(4-year)

University of Florida
College of Engineering
Chemical Engineering Department
Gainesville, Florida 32611
(4-year)

University of Florida
Department of Environmental Engineering Sciences
Gainesville, Florida 32611
(Graduate)

University of Miami
Mechanical Engineering Department
University Station
Coral Gables, Florida 33124
(4-year; Graduate)

Georgia

Georgia Institute of Technology
College of Engineering
225 North Avenue, N.W.
Atlanta, Georgia 30332
(Certificate)

Illinois

Northwestern University
Civil Engineering Department
The Technological Institute
Room 2474
Evanston, Illinois 60201
(Graduate)

Northwestern University
School of Engineering
The Technological Institute
Evanston, Illinois 60201
(4-year)

Southern Illinois University at Carbondale
Department of Thermal and Environmental Engineering
Carbondale, Illinois 62901
(4-year)

Southern Illinois University at Edwardsville
Department of Engineering and Technology
School of Science and Technology
Edwardsville, Illinois 62025
(4-year)

University of Illinois at Chicago Circle
Energy Engineering Department
601 South Morgan
Chicago, Illinois 60607
(4-year)

Waubonsee Community College
Occupational Programs
Illinois Route 47 at Harter Road
Sugar Grove, Illinois 60554
(Certificate; 2-year)

Indiana

Indiana Institute of Technology
Department of Engineering
1600 East Washington Boulevard
Fort Wayne, Indiana 46803
(4-year)

Purdue University
School of Civil Engineering
West Lafayette, Indiana 47907
(4-year; Graduate)

Purdue University
Department of Agricultural Engineering
West Lafayette, Indiana 47907
(Graduate)

Rose-Hulman Institute of Technology
Civil Engineering Department
Terre Haute, Indiana 47803
(4-year)

University of Notre Dame
Civil Engineering Department
Notre Dame, Indiana 46556
(4-year; Graduate)

Iowa

Iowa Lakes Community College
Science Department
101 1/2 North Sixth Street
Estherville, Iowa 51334
(2-year)

Kansas

Kansas State University
Mechanical Engineering Department
E 108 Seaton Hall
Manhattan, Kansas 66506
(4-year; Graduate)

Kansas Technical Institute
Civil Engineering Technology Department
2409 Scanlan Avenue
Salina, Kansas 67401
(2-year)

Kentucky

University of Kentucky
Department of Agricultural Engineering
Lexington, Kentucky 40506
(4-year; Graduate)

University of Louisville
Interdisciplinary Program in Chemical and Environmental Engineering
Speed Scientific School
Louisville, Kentucky 40208
(4-year; Graduate)

Western Kentucky University
Engineering Technology Department
Bowling Green, Kentucky 42101
(4-year)

Maryland

Garrett Community College
Mathematics-Science Division
Mosser Road
McHenry, Maryland 21541
(2-year)

Johns Hopkins University
Department of Geography and Environmental Engineering
34th and Charles Streets
Baltimore, Maryland 21218
(Graduate)

University of Maryland
Department of Civil Engineering
College Park, Maryland 20742
(4-year)

Massachusetts

Boston University
College of Engineering
Human Environmental Institute
110 Cunnington Street
Boston, Massachusetts 02215
(No degree)

Massachusetts Institute of Technology
Interdepartmental Program in Environmental Engineering
Cambridge, Massachusetts 02139
(4-year; Graduate)

Northeastern University
Lincoln College
219 Hayden Hall
360 Huntington Avenue
Boston, Massachusetts 02115
(4-year)

Northeastern University
Civil Engineering Department
College of Engineering
360 Huntington Avenue
Boston, Massachusetts 02115
(4-year; Graduate)

Northeastern University
Graduate School of Engineering
Boston, Massachusets 02115
(Graduate)

Northern Essex Community College
Division of Engineering and Technical Studies
100 Elliot Street
Haverhill, Massachusetts 01830
(2-year)

Quinsigamond Community College
College of Business and Para-Professional Career Programs
Division of Health Sciences
670 West Boylston Street
Worcester, Massachusetts 01606
(2-year)

Springfield Technical Community College
Division of Engineering Technologies
Armory Square
Springfield, Massachusetts 01105
(2-year)

University of Lowell
College of Engineering
Civil and Nuclear Engineering Program
1 University Avenue
Lowell, Massachusetts 01854
(4-year; Graduate)

University of Massachusetts at Amherst
Civil Engineering Department
Amherst, Massachusetts 01003
(4-year; Graduate)

Wentworth Institute
Civil Engineering Technology
550 Huntington Avenue
Boston, Massachusetts 02115
(2-year)

Worcester Polytechnic Institute
Environmental Engineering and Science Program
Worcester, Massachusetts 01609
(4-year)

Worcester Polytechnic Institute
Chemical Engineering Department
Worcester, Massachusetts 01609
(4-year)

Worcester Polytechnic Institute
Department of Civil Engineering
Worcester, Massachusetts 01609
(4-year)

Michigan

Detroit Institute of Technology
Civil Engineering Department
2727 Second Avenue
Detroit, Michigan 48201
(4-year)

Michigan State University
Department of Civil and Sanitary Engineering
East Lansing, Michigan 48824
(4-year; Graduate)

Michigan State University
Department of Fisheries and Wildlife
East Lansing, Michigan 48824
(4-year; Graduate)

Monroe County Community College
Division of Science and Mathematics
1555 South Raisinville Road
Monroe, Michigan 48161
(2-year)

University of Detroit
Department of Civil Engineering
4001 West McNichols Road
Detroit, Michigan 48221
(4-year; Graduate)

University of Michigan
College of Engineering
Ann Arbor, Michigan 48104
(4-year)

Western Michigan University
Paper Science and Engineering Department
Kalamazoo, Michigan 49008
(4-year)

Minnesota

University of Minnesota
Institute of Technology
112 Mineral and Metallurgical Engineering Building
Minneapolis, Minnesota 55455
(4-year)

Mississippi

Mississippi State University
Civil Engineering Department
Mississippi State, Mississippi 39762
(4-year; Graduate)

Missouri

University of Missouri at Kansas City
Engineering Department
1122 East 48th Street
Kansas City, Missouri 64101
(4-year)

Montana

Montana College of Mineral Science and Technology
Environmental Engineering Department
Butte, Montana 59701
(4-year)

New Hampshire

Dartmouth College
Department of Engineering and Engineering Sciences
Hanover, New Hampshire 03755
(4-year; Graduate)

University of New Hampshire
College of Engineering and Physical Sciences
Department of Civil Engineering
Durham, New Hampshire 03824
(4-year)

New Jersey

Bergen Community College
Department of Biological Sciences
Environmental Technology Program
400 Paramus Road
Paramus, New Jersey 07652
(2-year)

New Jersey Institute of Technology
Department of Civil and Environmental Engineering
323 High Street
Newark, New Jersey 07102
(4-year; Graduate)

Stevens Institute of Technology
Mechanical Engineering Department
Hoboken, New Jersey 07030
(Certificate; Graduate)

New Mexico

New Mexico Institute of Mining and Technology
Department of Petroleum and Mining Engineering
Socorro, New Mexico 87801
(4-year)

University of New Mexico
Department of Civil Engineering
Albuquerque, New Mexico 87131
(4-year; Graduate)

New York

City University of New York
City College
Environmental Control Technology Program
300 Jay Street
Brooklyn, New York 11201
(2-year)

City University of New York
City College
Civil Engineering Department
Convent Avenue at 138th Street
New York, New York 10031
(4-year; Graduate)

Clarkson College
Mechanical and Industrial Engineering Department
Potsdam, New York 13676
(4-year; Graduate)

Clarkson College
Chemical Engineering Department
Potsdam, New York 13676
(4-year; Graduate)

Clarkson College
Civil and Environmental Engineering Department
Potsdam, New York 13676
(4-year; Graduate)

Columbia University
School of Engineering and Applied Science
Department of Civil Engineering and Engineering Mechanics
New York, New York 10027
(4-year)

Cooper Union
Interdisciplinary Engineering Program
Cooper Square
New York, New York 10003
(4-year; Graduate)

Cornell University
College of Engineering
Department of Environmental Engineering
Ithaca, New York 14853
(4-year; Graduate)

Polytechnic Institute of New York
Civil and Environmental Engineering Department
Brooklyn, New York 11201
(Certificate; Graduate)

Rensselaer Polytechnic Institute
Department of Chemical and Environmental Engineering
Troy, New York 12181
(4-year; Graduate)

State University of New York at Syracuse
College of Environmental Science and Forestry
School of Environmental and Resource Engineering
Syracuse, New York 13210
(4-year; Graduate)

Syracuse University
L.C. Smith College of Engineering
Syracuse, New York 13270
(4-year)

Syracuse University
Civil Engineering Department
Syracuse, New York 13210
(Graduate)

Union College
Division of Engineering and Applied Science
Schenectady, New York 12308
(4-year)

University of Rochester
Interdepartmental Program in Chemical Engineering
Rochester, New York 14601
(4-year)

North Carolina

Duke University
Civil Engineering Department
Durham, North Carolina 27706
(Graduate)

Fayetteville Technical Institute
Department of Environmental Engineering Technology
P.O. Box 5236
Fayetteville, North Carolina 28303
(2-year)

North Carolina State University
Civil Engineering Department
Raleigh, North Carolina 27611
(Graduate)

Pitt Technical Institute
Department of Air and Water Resources
P.O. Drawer 7007
Greenville, North Carolina 27834
(2-year)

University of North Carolina at Chapel Hill
Environmental Sciences and Engineering
School of Public Health
Chapel Hill, North Carolina 27514
(Graduate)

University of North Carolina at Charlotte
Department of Urban and Environmental Engineering
UNCC Station
Charlotte, North Carolina 28223
(4-year)

Ohio

Case Western Reserve University
Chemical Engineering Department
Cleveland, Ohio 44101
(4-year; Graduate)

Cleveland State University
Chemical Engineering Department
Euclid Avenue at East 24th Street
Cleveland, Ohio 44115
(4-year; Graduate)

Jefferson County Technical Institute
Environmental Engineering Technology Program
4000 Sunset Boulevard
Steubenville, Ohio 43952
(2-year)

Muskingum Area Technical College
Division of Engineering and Science
1555 Newark Road
Zanesville, Ohio 43701
(2-year)

University of Cincinnati
Civil and Environmental Engineering Department
College of Engineering
Cincinnati, Ohio 45267
(Graduate)

University of Dayton
Chemical Technology and Environmental Engineering Technology
Dayton, Ohio 45469
(2-year)

University of Toledo
College of Engineering
2801 West Bancroft Street
Toledo, Ohio 43606
(4-year; Graduate)

Oklahoma

Eastern Oklahoma State College
Division of Engineering and Science
Wiburton, Oklahoma 74578
(2-year)

University of Oklahoma
Department of Civil Engineering and Environmental Science
Norman, Oklahoma 73019
(4-year; Graduate)

Oregon

Oregon Institute of Technology
Division of Engineering Technology
Oretech Post Office
Klamath Falls, Oregon 97601
(4-year)

Pennsylvania

Carnegie-Mellon University
Carnegie Institute of Technology,
Engineering and Public Policy
Pittsburgh, Pennsylvania 15213
(Graduate)

Drexel University
Environmental Studies Institute
Philadelphia, Pennsylvania 19104
(Graduate)

Drexel University
Civil Engineering Department
Philadelphia, Pensylvania 19104
(Graduate)

Lehigh University
Chemical Engineering
College of Engineering and Physical Sciences
Bethlehem, Pennsylvania 18015
(4-year)

Lehigh University
Civil Engineering Department
Bethlehem, Pennsylvania 18015
(4-year; Graduate)

Pennsylvania State University
Graduate Programs in Environmental Pollution Control
226 Merrel R. Fenske Laboratory
University Park, Pennsylvania 16802
(Graduate)

Pennsylvania State University
Civil Engineering Department
212 Sackett Building
University Park, Pennsylvania 16802
(4-year; Graduate)

Temple University
College of Engineering Technology
Philadelphia, Pennsylvania 19122
(2-year; 4-year)

University of Pennsylvania
Civil and Urban Engineering Program
College of Engineering and Applied Sciences
Philadelphia, Pennsylvania 19174
(Graduate)

University of Pittsburgh
Department of Civil Engineering
949 BEH
Pittsburgh, Pennsylvania 15261
(4-year; Graduate)

University of Pittsburgh
Environmental Systems Engineering Program
School of Engineering
1140 Benedum Hall
Pittsburgh, Pennsylvania 15261
(Graduate)

Puerto Rico

University of Puerto Rico
Environmental Technology Program
Aquadella Campus
Aquadella, Puerto Rico 00603
(2-year)

Rhode Island

Rhode Island Junior College
Division of Vocational Technology Education
Knight Campus
Warwick, Rhode Island 02886
(2-year)

University of Rhode Island
Department of Civil and Environmental Engineering
Kingston, Rhode Island 02881
(4-year; Graduate)

South Carolina

Clemson University
Environmental Systems Engineering
Clemson, South Carolina 29631
(Graduate)

Greenville Technical College
Environmental Chemical Technology
South Pleasantburg Drive
291 Bypass
P.O. Box 5616
Greenville, South Carolina 29606
(2-year)

Sumter Area Technical College
Technical Division
506 Guignard Drive
Sumter, South Carolina 29150
(2-year)

University of South Carolina
College of Engineering
Columbia, South Carolina 29201
(4-year; Graduate)

Tennessee

Memphis State University
Department of Civil Engineering
Memphis, Tennessee 38152
(Graduate)

University of Tennessee at Nashville
Division of Engineering
Tenth And Charlotte
Nashville, Tennessee 37203
(4-year; Graduate)

Vanderbilt University
Department of Environmental Engineering and Policy Management
Nashville, Tennessee 37240
(4-year)

Texas

Texas A&M University
Department of Civil Engineering
College Station, Texas 77843
(4-year; Graduate)

University of Texas at Austin
Civil Engineering Department
Austin, Texas 78712
(Graduate)

University of Texas at Austin
College of Engineering
Austin, Texas 78712
(4-year)

University of Texas at El Paso
Department of Civil Engineering
El Paso, Texas 79968
(4-year; Graduate)

University of Texas of the Permian Basin
Control Engineering Department
Odessa, Texas 79762
(4-year; Graduate)

Vermont

Norwich University/Vermont College
Engineering and Technology Department
Northfield, Vermont 05663
(4-year; Graduate)

University of Vermont
Civil Engineering Department
Burlington, Vermont 05401
(4-year; Graduate)

Virginia

Hampton Institute
Civil Engineering Department
Hampton, Virginia 23668
(4-year)

J. Sargeant Reynolds Community College
Division of Engineering and Engineering Technology
Richmond, Virginia 23241
(2-year)

Washington

Gonzaga University
School of Engineering
Spokane, Washington 99258
(4-year)

Shoreline Community College
Division of Science and Social Science
16101 Greenwood Avenue, North
Seattle, Washington 98133
(2-year)

West Virginia

Bluefield State College
Civil Engineering Technology
Bluefield, West Virginia 24701
(2-year; 4-year)

Parkersburg Community College
Environmental Engineering Technology Program
Parkersburg, West Virginia 26101
(Certificate; 2-year)

West Virginia College of Graduate Studies
Faculty of Engineering and Science
Institute, West Virginia 25112
(Graduate)

West Virginia University
Civil Engineering Department
Morgantown, West Virginia 26506
(4-year; Graduate)

Wisconsin

University of Wisconsin at Madison
Department of Civil and Environmental Engineering
2205 Engineering Building
Madison, Wisconsin 53706
(4-year; Graduate)

University of Wisconsin at Milwaukee
Department of Civil Engineering
Engineering and Mathematical Sciences
Milwaukee, Wisconsin 53201
(4-year)

Wyoming

University of Wyoming
Department of Civil and Architectural Engineering
P.O. Box 3334
University Station, Wyoming 82071
(4-year; Graduate)

12. Environmental Studies Programs

Alabama

Alabama A & M University
Community Planning Department
Normal, Alabama 35762
(4-year)

Jefferson State Junior College
Division of Social Sciences
Urban Planning and Development Program
2601 Carson Road
Birmingham, Alabama 35215
(2-year)

Southern Union State Junior College
Occupational Education Programs (Aquatic Technology)
Wadley, Alabama 36276
(2-year)

Alaska

University of Alaska
Interdepartmental Program in Environmental Quality Engineering and Environmental Quality Science
Fairbanks, Alaska 99701
(Graduate)

Arizona

Northern Arizona University
Interdepartmental Program in Environmental Studies
Center for Integrated Studies
P.O. Box 4103
Flagstaff, Arizona 86011
(4-year)

Arkansas

Southern Arkansas University
Southwestern Technical Institute
Interdepartmental Program in Environmental Control Technology
P.O. Box 3048
East Camden, Arkansas 71701
(2-year)

California

Ambassador College
Joint Sciences Department
Environmental Studies Program
300 West Green Street
Pasadena, California 91123
(4-year)

California State College at Dominguez Hills
The Small College (Interdisciplinary)
1000 East Victoria Street
Dominguez Hills, California 90747
(4-year)

California State College at San Bernardino
Interdepartmental Program in Environmental Studies
5500 State College Parkway
San Bernardino, California 92407
(4-year)

California State University at Fresno
Interdisciplinary Program in Environmental Studies
Fresno, California 93740
(4-year)

California State University at Fullerton
Interdepartmental Program in Environmental Studies
Fullerton, California 92634
(Graduate)

California State University at Hayward
Earth Sciences Department
Environmental Geology Program
Hayward, California 94542
(Graduate)

California State University at Hayward
Interdepartmental Program in Environmental Studies
Hayward, California 94542
(4-year)

California State University at Long Beach
Interdepartmental Program
Center for Environmental Studies
1250 Bell Flower Boulevard
Long Beach, California 90840
(Certificate; 4-year)

California State University at Sacramento
Environmental Studies Center
6000 J Street
Sacramento, California 95819
(4-year; Graduate)

College of Alameda
Interdepartmental Program in Environmental Studies
555 Atlantic Avenue
Alameda, California 94501
(2-year)

College of Marin
Biological Science Department
Kent Field, California 94904
(2-year)

Consortium of California State Universities and Colleges
Environmental Planning Program
400 Golden Shore
Long Beach, California 90802
(Certificate; Graduate)

East Los Angeles College
Life Sciences Department
5357 East Brooklyn Avenue
Los Angeles, California 90022
(2-year)

Los Angeles City College
Life Sciences Department
855 North Vermont Avenue
Los Angeles, California 90020
(2-year)

Los Angeles Mission College
Interdepartmental Program in Environmental Studies
1101 San Fernando Road
San Fernando, California 91340
(2-year)

Los Angeles Pierce College
Department of Earth and Life Sciences
6201 Winnetka Avenue
Woodland Hills, California 91371
(2-year)

Los Angeles Trade and Technical College
Department of Science and Mathematics
400 West Washington Boulevard
Los Angeles, California 90015
(2-year)

Mount San Antonio College
Interdepartmental Program in Environmental Studies
1100 North Grand Avenue
Walnut, California 91789
(2-year)

Pitzer College
Interdepartmental Program in Environmental Studies
1050 North Mills Avenue
Claremont, California 91711
(4-year)

Saddleback Community College
Environmental Studies Department
2800 Marguerite Parkway
Mission Viejo, California 92675
(2-year)

San Bernardino Valley College
Geography Department
Urban Planning and Environmental Management Program
701 South Mount Vernon Avenue
San Bernardino, California 92403
(2-year)

San Diego State University
Biology Department
San Diego, California 92182
(Graduate)

San Jose State University
Biological Sciences Department
San Jose, California 95192
(4-year; Graduate)

San Jose State University
Department of Geography and Environmental Studies
125 South Seventh Street
San Jose, California 95192
(4-year)

Santa Ana College
Environmental Studies Department
17th at Bristol
Santa Ana, California 92706
(2-year)

University of California at Berkeley
Division of Special Programs
Berkeley, California 94720
(4-year)

University of California at Davis
Department of Resource Science and Engineering
Environmental Planning and Management Program
Davis, California 95616
(4-year)

University of California at Davis
Interdepartmental Program in Ecology
Davis, California 95616
(Graduate)

University of California at Davis
Department of Environmental Horticulture
Davis, California 95616
(4-year, Graduate)

University of California at Irvine
Interdepartmental Program in Social Ecology
Irvine, California 92664
(4-year; Graduate)

University of California at Irvine
Department of Ecology and Evolutionary Biology
Irvine, California 92664
(4-year; Graduate)

University of California at Riverside
Statistics Department
Systems Ecology Program
Riverside, California 92502
(4-year)

University of California at Riverside
Earth Science Department
Riverside, California 92502
(4-year)

University of California at Santa Barbara
Biological Science Department
Santa Barbara, California 93106
(4-year)

University of California at Santa Barbara
Interdepartmental Program in Environmental Studies
Santa Barbara, California 93106
(4-year)

University of California at Santa Cruz
Interdepartmental Program in Environmental Studies
Santa Cruz, California 95064
(4-year)

Colorado

Colorado Northwestern Community College
Liberal Arts Department
Program in the Humanistic Approach to the Environment
Rangely, Colorado 81648
(2-year)

Community College of Denver
Service Occupations Division
Environmental Technology Program
12600 West 6th Avenue
Golden, Colorado 80401
(2-year)

Regis College
Interdepartmental Program in Environmental Studies and Human Ecology
3539 West 50th Avenue
Denver, Colorado 80221
(4-year)

University of Colorado at Boulder
Department of Environmental Population and Organismic Biology
Boulder, Colorado 80309
(4-year; Graduate)

University of Northern Colorado
Interdepartmental Program in Environmental Studies
Greeley, Colorado 80639
(4-year)

Connecticut

Central Connecticut State College
Environmental Management Program
New Britain, Connecticut 06050
(4-year)

Environmental Education Center
800 Dixwell Avenue
New Haven, Connecticut 86511
(No degree)

Northwestern Connecticut Community College
Environmental Technology Program
Park Place
Winsted, Connecticut 06098
(2-year)

Southern Connecticut State College
Environmental Studies Council
501 Crescent Street
New Haven, Connecticut 06515
(4-year)

Southern Connecticut State College
Department of Science and Environmental Education
501 Crescent Street
New Haven, Connecticut 06515
(Graduate)

Southern Connecticut State College
Biology Department
501 Crescent Street
New Haven, Connecticut 06515
(4-year; Graduate)

Southern Connecticut State College
Earth Science Department
501 Crescent Street
New Haven, Connecticut 06515
(4-year)

Trinity College
Interdisciplinary Program in Urban and Environmental Studies
Hartford, Connecticut 06106
(4-year)

Tunxis Community College
Department of Liberal Arts and Science
Environmental Economics and Environmental Science Option
Farmington, Connecticut 06032
(2-year)

University of Hartford
College of Engineering
200 Bloomfield Avenue
West Hartford, Connecticut 06117
(Certificate)

University of New Haven
Department of Biology
Environmental Studies and General Science
300 Orange Avenue
West Haven, Connecticut 06516
(2-year; 4-year; Graduate)

Waterbury State Technical College
Chemical Technology Department
1460 West Main Street
Waterbury, Connecticut 06708
(2-year)

Wesleyan University
Interdepartmental Program in Environmental and Urban Studies
Middletown, Connecticut 06457
(4-year)

Western Connecticut State College
Division of Graduate Studies
Department of Biological and Environmental Studies
181 White Street
Danbury, Connecticut 06810
(Graduate)

Yale University
School of Forestry and Environmental Studies
205 Prospect Street
New Haven, Connecticut 06511
(Graduate)

Delaware

Delaware State College
Environmental Education Workshop
Dover, Delaware 19901
(No degree)

Delaware State College
Department of Agriculture and Natural Resources
Dover, Delaware 19901
(4-year)

Wesley College
Career Direction in Environmental Studies
Dover, Delaware 19901
(2-year)

District of Columbia

The American University
College of Public Affairs
Center for Technology and Administration
Massachusetts and Nebraska Avenues, N.W.
Washington, D.C. 20016
(Graduate)

The American University
Division of Continuing Education
Environmental Systems Management
Massachusetts and Nebraska Avenues, N.W.
Washington, D.C. 20016
(Certificate; Graduate)

The American University
Interdepartmental Science
College of Arts and Sciences
Environmental Studies Committee
Massachusetts and Nebraska Avenues, N.W.
Washington, D.C. 20016
(4-year)

George Washington University
National Law Center
Washington, D.C. 20052
(Graduate)

George Washington University
Interdepartmental Programs in Environmental Studies
Columbian College of Arts and Sciences
Washington, D.C. 20052
(4-year)

Florida

Florida Institute of Technology
Department of Oceanography
Melbourne, Florida 32901
(4-year; Graduate)

Florida Institute of Technology
Department of Oceanography and Ocean Engineering
Chemical Oceanography Program
Melbourne, Florida 32901
(4-year; Graduate)

Florida Institute of Technology
Science Education Department
Melbourne, Florida 32901
(4-year; Graduate)

Florida Institute of Technology
Natural Sciences and Environmental Technology Department
Environmental Technology-Aquaculture Option
Jensen Beach, Florida 33457
(4-year)

Florida International University
Physical Sciences Division
Tamiami Trail
Miami, Florida 33199
(4-year)

Florida State University
Department of Urban and Regional Planning
Tallahassee, Florida 32306
(Graduate)

Florida State University
Oceanography Department
Tallahassee, Florida 32306
(4-year)

Miami-Dade Community College
Marine Science Technology Department
1090 N.W. North River Drive
Miami, Florida 33136
(2-year)

Rollins College
Environmental Studies Department
Winter Park, Florida 32789
(4-year)

University of Florida
School of Forest Resources and Conservation
College of Agriculture
Gainesville, Florida 32611
(4-year)

University of Florida
College of Agriculture
Gainesville, Florida 32611
(Certificate)

University of Florida
Department of Urban and Regional Planning
Gainesville, Florida 32611
(Graduate)

University of Florida
College of Agriculture
Gainesville, Florida 32611
(4-year; Graduate)

University of Miami
Rosenstiel School of Marine and Atmospheric Science
4600 Rickenbacker Causeway
Miami, Florida 33149
(Graduate)

University of Miami
Department of Architecture and Planning
University Station
Coral Gables, Florida 33124
(Graduate)

University of Tampa
Division of Science and Mathematics
Marine Science Program
401 West Kennedy Boulevard
Tampa, Florida 33606
(4-year)

University of West Florida
Department of Earth and Atmospheric Sciences
Pensacola, Florida 32504
(4-year)

Georgia

Fort Valley State College
Agricultural Engineering Department
State College Drive
Fort Valley, Georgia 31030
(4-year)

Georgia Institute of Technology
College of Architecture
City Planning/Urban Design Program
225 North Avenue, N.W.
Atlanta, Georgia 30332
(Graduate)

Georgia State University
Community Development
College of Urban Life
Environmental Management Program
University Plaza
Atlanta, Georgia 30303
(4-year; Graduate)

Morehouse College
Urban Studies Program
223 Chestnut Street, S.W.
Atlanta, Georgia 30314
(4-year)

Shorter College
Natural Science Department
Shorter Hill
Rome, Georgia 30161
(4-year)

University of Georgia
Department of Agronomy
Athens, Georgia 30602
(4-year)

University of Georgia
School of Forest Resources
Athens, Georgia 30602
(Graduate)

West Georgia College
Interdisciplinary Program in Environmental Studies
Carrollton, Georgia 30118
(2-year)

Hawaii

University of Hawaii at Manoa
Interdepartmental Liberal Studies Program
Environmental Studies Program
Honolulu, Hawaii 96822
(4-year)

Idaho

The College of Idaho
Interdepartmental Program
Human Ecology Dimension
Caldwell, Idaho 83605
(4-year)

The Ricks College
Biology Department
Rexberg, Idaho 83440
(2-year)

Illinois

De Paul University
Chemistry Department
Lincoln Park Campus
2323 North Seminary Avenue
Chicago, Illinois 60614
(4-year)

George Williams College
Leisure and Environmental Resources Administration Department
555 Thirty-first Street
Downers Grove, Illinois 60515
(Graduate)

Roosevelt University
Center for the Urban Environment
430 South Michigan Avenue
Chicago, Illinois 60605
(4-year)

Sangamon State University
Department of Environments and People
Springfield, Illinois 62708
(4-year; Graduate)

Southern Illinois University
Geography Department
Carbondale, Illinois 62901
(4-year; Graduate)

Indiana

Ball State University
Department of Natural Resources
Room 110
West Quadrangle
Muncie, Indiana 47306
(4-year; Graduate)

Indiana Vocational Technical College
Trade and Technical Department
5221 Ivy Tech Drive
Indianapolis, Indiana 46268
(2-year)

Manchester College
Interdivisional Environmental Studies Program
North Manchester, Indiana 46962
(4-year)

University of Evansville
Chemistry Department
P.O. Box 329
Evansville, Indiana 47702
(4-year)

Iowa

Briar Cliff College
Biology Department
3303 Rebecca Street
Sioux City, Iowa 51104
(4-year)

Coe College
Interdepartmental Environmental Studies Program
Cedar Rapids, Iowa 52402
(4-year)

Cornell College
Interdisciplinary Program in Environmental Studies
Mount Vernon, Iowa 52314
(4-year)
Iowa State University
Interdisciplinary Program in Environmental Studies
141 Bessey Hall
Ames, Iowa 50011
(4-year)

Luther College
Biology Department
Decorah, Iowa 52101
(4-year)

University of Northern Iowa
College of Natural Sciences
1222 West 27th Street
Cedar Falls, Iowa 50613
(4-year)

Kansas

Bethel College
Division of Nontraditional Education
Environmental Studies Program
North Newton, Kansas 67117
(4-year)

Ottawa University
Center for the Study of Human Interaction with the Environment
Box 102
Ottawa, Kansas 66067
(4-year)

University of Kansas
Interdisciplinary Program in Environmental Studies
Snow Hall
Lawrence, Kansas 66043
(4-year)

Kentucky

Eastern Kentucky University
Department of Biological Sciences
Richmond, Kentucky 40475
(4-year; Graduate)

Morehead State University
Center for Environmental Studies
Morehead, Kentucky 40351
(4-year)

Union College
Division of Natural Sciences
Barbourville, Kentucky 40906
(4-year)

Maine

Bowdoin College
Committee on Environmental Studies
Brunswick, Maine 04011
(4-year)

Saint Francis College
Center for Life Science
Biddeford, Maine 04005
(4-year)

University of Maine at Fort Kent
Environmental Studies Committee
Fort Kent, Maine 04743
(4-year)

University of Maine at Orono
College of Life Sciences and Agriculture
Technical Division
Resource and Business Management
Orono, Maine 04473
(2-year)

University of Maine at Orono
Interdisciplinary Program in Resource Utilization
206 Winslow Hall
Orono, Maine 04473
(Graduate)

Maryland

Anne Arundel Community College
Department of Environmental Research
Protection and Development
Arnold, Maryland 21012
(2-year)

College of Notre Dame of Maryland
Biological Sciences Department
4701 North Charles Street
Baltimore, Maryland 21210
(4-year)

Hood College
Environmental Studies Program
Frederick, Maryland 21701
(4-year; Graduate)

Prince George's Community College
Urban and Environmental Studies Program
301 Largo Road
Largo, Maryland 20870
(2-year)

University of Maryland
College of Agriculture
College Park, Maryland 20742
(4-year; Graduate)

Massachusetts

Boston State College
Urban Studies Department
625 Huntington Avenue
Boston, Massachusetts 02115
(Graduate)

Boston University
Environmental Studies and Resource Management
755 Commonwealth Avenue
Boston, Massachusetts 02215
(No degree)

Clark University
Interdisciplinary Program in Environmental Affairs
950 Main Street
Worcester, Massachusetts 01610
(4-year; Graduate)

Dean Junior College
Department of Mathematics and Sciences
Franklin, Massachusetts 02038
(2-year)

Leicester Junior College
Mathematics and Science Department
Leicester, Massachusetts 01524
(2-year)

Lesley College
Division of Sciences
29 Everett Street
Cambridge, Massachusetts 02138
(4-year)

Massachusetts Institute of Technology
Interdepartmental Environmental Studies Program
Cambridge, Massachusetts 02139
(4-year; Graduate)

Simon's Rock Early College
Interdisciplinary Program in Environmental Studies
Great Barrington, Massachusetts 01230
(4-year)

Stonehill College
Environmental Studies Program
College of Arts and Sciences
North Easton, Massachusetts 02356
(1-year)

Suffolk University
College of Liberal Arts and Sciences
Environmental Technology Program
41 Temple Street
Beacon Hill
Boston, Massachusetts 02114
(4-year)

University of Lowell
Interdisciplinary Environmental Studies Program
Lowell, Massachusetts O1854
(4-year; Graduate)

University of Massachusetts at Boston
Urban Technology and Community Health Programs

College of Professional Studies
Harbor Campus
Boston, Massachusetts 02125
(4-year)

Williams College
Center for Environmental Studies
Williamstown, Massachusetts 01267
(4-year)

Worcester State College
Biology Department
486 Chandler Street
Worcester, Massachusetts 01602
(4-year)

Michigan

Aquinas College
Environmental Studies Department
Grand Rapids, Michigan 49506
(4-year)

Grand Valley State College
William James College
Urban and Environmental Studies Program
Allendale, Michigan 49401
(4-year)

Michigan State University
Department of Electrical Engineering and Systems Science
East Lansing, Michigan 48824
(Graduate)

Oakland University
Interdisciplinary Program in Environmental Studies
Rochester, Michigan 48063
(4-year)

University of Michigan
School of Natural Resources
Environmental Education Program
Samuel Trask Dana Buiding
Room 2006
Ann Arbor, Michigan 48104
(4-year; Graduate)

Western Michigan University
Interdepartmental Environmental Studies Program
Kalamazoo, Michigan 49008
(4-year)

Minnesota

Austin Community College
Career Program in Environmental Technology
1600 8th Avenue, N.W.
Austin, Minnesota 55912
(2-year)

Bemidji State University
Division of Science and Mathematics
Center for Environmental Studies
Bemidji, Minnesota 56601
(4-year; Graduate)

Concordia College
Interdepartmental Program in Environmental Studies
Moorhead, Minnesota 56560
(4-year)

Macalester College
Interdepartmental Program in Environmental Studies
St. Paul, Minnesota 55105
(4-year)

Mankato State University
Interdisciplinary Program in Environmental Studies
Mankato, Minnesota 56001
(4-year)

Saint Cloud State University
Interdepartmental Program in Environmental Studies
Saint Cloud, Minnesota 56301
(4-year)

Tri College Center for Environmental Studies
Science and Math Building, Room 104
Concordia College
Moorhead, Minnesota 56560
(4-year)

Mississippi

Mississippi State University
Interdepartmental Environmental Studies Program
Mississippi State, Mississippi 39762
(Graduate)

University of Southern Mississippi
Department of Community and Regional Planning
Hattiesburg, Mississippi 39401
(4-year)

University of Southern Mississippi
Department of Geography and Area Development
Hattiesburg, Mississippi 39401
(4-year; Graduate)

Missouri

The Principia
Interdepartmental Program in Environmental Studies or Environmental Sciences
Elsah, Missouri 62028
(4-year)

Southwest Missouri State University
Chemistry Department
901 South National
Springfield, Missouri 65802
(4-year)

Montana

Montana State University
Biology Department
Entomology, Fish and Wildlife Management
Bozeman, Montana 59715
(Graduate)

University of Montana
Interdisciplinary Environmental Studies Program
758 Eddy Street
Missoula, Montana 59812
(Graduate)

Nebraska

Dana College
Interdepartmental Environmental Studies Program
Blair, Nebraska 68008
(4-year)

Doane College
Interdepartmental Program in Environmental Studies
Crete, Nebraska 68333
(4-year)

Kearney State College
Biology Department
905 West 25th Street
Kearney, Nebraska 68847
(4-year)

Kearney State College
Interdepartmental Environmental Studies Program
905 West 25th Street
Kearney, Nebraska 68847
(4-year)

Southeast Community College
Environmental Laboratory Technology Program
2240 Vine Street
Lincoln, Nebraska 68503
(2-year)

Nevada

Western Nevada Community College
Arts and Sciences Department
Environmental Studies Program
2201 West Nye Lane
Carson City, Nevada 89701
(2-year)

Western Nevada Community College
Arts and Sciences Department
Environmental Studies Program
North Campus
7000 El Rancho Drive
Sparks, Nevada 89431
(2-year)

New Hampshire

Dartmouth College
Engineering Science Department
Hanover, New Hampshire 03755
(4-year)

Dartmouth College
Environmental Studies Department
Hanover, New Hampshire 03755
(4-year)

Nathaniel Hawthorne College
Physical Science Department
Antrim, New Hampshire 03440
(4-year)

New England College
Environmental Studies and Earth Science Division
Henniker, New Hampshire 03242
(4-year)

University of New Hampshire/Plymouth State College
Environmental Studies Center
Plymouth, New Hampshire 03264
(Certificate)

University of New Hampshire
Institute of Natural and Environmental Resources
Durham, New Hampshire 03824
(4-year; Graduate)

New Jersey

Bergen Community College
Department of Biological Sciences and Physical Sciences and Math
400 Paramus Road
Paramus, New Jersey 07652
(2-year)

Bloomfield College
Biology Department
Bloomfield, New Jersey 07003
(4-year)

Glassboro State College
Department of Biological Sciences, Humanities, and Social Sciences
Glassboro, New Jersey 08028
(4-year)

Jersey City State College
Biology Department
2039 Kennedy Memorial Boulevard
Jersey City, New Jersey 07305
(4-year)

Kean College of New Jersey
Interdisciplinary Program in Environmental Studies
Union, New Jersey 07083
(4-year)

Princeton University
Center for Environmental Studies
Princeton, New Jersey 08540
(1-year; 4-year)

Ramapo College of New Jersey
School of Environmental Studies
P.O. Box 542
Ramapo Valley Road
Mahwah, New Jersey 07430
(4-year)

Ramapo College of New Jersey
School of Human Environment
P.O. Box 542
Mahwah, New Jersey 07430
(4-year)

Richard Stockton State College
Environmental Studies Department
Pomona, New Jersey 08240
(4-year)

Rutgers, The State University of New Jersey
Environmental Science Department
Georges Road Laboratories
Cook College
New Brunswick, New Jersey 08903
(4-year)

Rutgers, The State University of New Jersey
Human Ecology and Social Sciences Department
212 Cook Office Building
Cook College
New Brunswick, New Jersey 08903
(4-year)

Rutgers, The State University of New Jersey
Agricultural Economics Department
215 Cook College
Office Boulevard
Cook Campus
New Brunswick, New Jersey 08903
(Graduate)

Rutgers, The State University of New Jersey
Agricultural Engineering Department
Biological and Agricultural Engineering Building
Cook Campus
New Brunswick, New Jersey 08903
(4-year; Graduate)

Rutgers, The State University of New Jersey
Department of Agricultural Economics
Room 213
Cook Office Building
Cook Campus
New Brunswick, New Jersey 08903
(4-year)

Somerset County College
Environmental and Laboratory Technology Program
P.O. Box 3300
Somerville, New Jersey 08876
(2-year)

Upsala College
Environmental Sciences I
Environmental Sciences II
East Orange, New Jersey 07019
(4-year)

William Paterson College of New Jersey
Multidisciplinary Environmental Studies Program
300 Pompton Road
Wayne, New Jersey 07470
(4-year)

New Mexico

New Mexico Institute of Mining Technology
Department of Psychology
Environmental Psychology Program
Socorro, New Mexico 87801
(4-year)

New Mexico Institute of Mining Technology
Department of Geoscience
Socorro, New Mexico 87801
(4-year; Graduate)

New York

Alfred University
Environmental Studies Department
Alfred, New York 14802
(4-year)

Barnard College
Committee of the Members of the Departments of Biology, Geography and Geology
Environmental Conservation and Management Program
Morningside Heights
606 West 120th Street
New York, New York 10027
(4-year)

City University of New York
City College
Environmental Studies Program
School of Education
Klapper Hall
Room 110
Convent Avenue at 138th Street
New York, New York 10031
(Graduate)

City University of New York
New York City Community College
Chemical Technology Program
300 Jay Street
Brooklyn, New York 11201
(2-year)

College of Mount Saint Vincent
Interdepartmental Program in Environmental Studies
On Hudson
Riverdale, New York 10471
(4-year)

Columbia-Greene Community College
Division of Mathematics and Science
Box 1000
Hudson, New York 12534
(2-year)

Community College of the Finger Lakes
Natural Resources Conservation
Lincoln Hill Road
Canandaigua, New York 14424
(Certificate; 2-year)

Cornell University
New York State College of Agriculture and Life Sciences
Waste Management Engineering Program
Ithaca, New York 14850
(Graduate)

Cornell University
New York State College of Agriculture and Life Sciences
Environmental Studies Program
Ithaca, New York 14850
(4-year)

Dutchess Community College
Biological Sciences Department
Natural Resources Conservation Program
Pendell Road
Poughkeepsie, New York 12601
(2-year)

Eisenhower College
Interdisciplinary Environmental Studies Program
Seneca Falls, New York 13148
(4-year)

Hartwick College
Environmental Perspectives Program
Oneonta, New York 13820
(4-year)

Hudson Valley Community College
Environmental Technology Department
Vandenburgh Avenue
Troy, New York 12180
(2-year)

Iona College
Biology Department
New Rochelle, New York 10801
(4-year)

New York Institute of Technology
Department of Life Sciences
1855 Broadway
New York, New York 10023
(4-year)

New York University
Urban Planning Department
Public Administration Program
70 Washington Square South
New York City, New York 10012
(Graduate)

New York University
Biology Department
70 Washington Square South
New York City, New York 10012
(Graduate)

Niagara County Community College
Division of Technology, Mathematics and Physical Science
Environmental Studies Program
3111 Saunders Settlement Road
Sanborn, New York 14132
(2-year)

Paul Smith's College
Ecology and Environmental Technology Division
Paul Smith's, New York 12970
(2-year)

Rensselaer Polytechnic Institute
Urban and Environmental Studies Department
Troy, New York 12181
(Graduate)

Saint John's University
College of Liberal Arts and Sciences
Environmental Studies Program
Jamaica, New York 11439
(4-year)

Saint Lawrence University
Interdisciplinary Program in Environmental Studies
Canton, New York 13617
(4-year)

State University of New York at Binghamton
Interdisciplinary Program in Environmental Studies
Binghamton, New York 13901
(4-year)

State University of New York at Binghamton
Department of Geological Sciences and Environmental Studies
Binghamton, New York 13901
(4-year)

State University of New York at Brooklyn
Department of Preventive Medicine and Community Health
Downstate Medical Center
450 Clarkson Avenue
Brooklyn, New York 11203
(Graduate)

State University of New York at Buffalo
Environmental Analysis and Policy Program
School of Management
Crosby Hall
Buffalo, New York 14214
(Graduate)

State University of New York at Buffalo
Environmental Studies Program
4230 Ridge Lea
Room B-53
Buffalo, New York 14214
(4-year)

State University of New York at Geneseo
Environmental Studies Program
College of Arts and Sciences
Geneseo, New York 14454
(4-year)

State University of New York at Stony Brook
Interdisciplinary Program in Environmental Studies
Stony Brook, New York 11794
(4-year)

State University of New York at Syracuse
College of Environmental Science and Forestry
Syracuse, New York 13210
(4-year; Graduate)

Union College
Interdisciplinary Program in Environmental Studies
Schenectady, New York 12308
(4-year)

University of Rochester
University College of Liberal and Applied Studies
Environmental Studies Program
Rochester, New York 14627
(Graduate)

University of Rochester
School of Medicine and Dentistry
Department of Radiation Biology and Biophysics
Rochester, New York 14627
(Graduate)

University of Rochester
College of Engineering and Applied Science
Chemical Engineering Department
Rochester, New York 14627
(Graduate)

North Carolina

Appalachian State University
Geography Department
Community and Regional Planning Program
Boone, North Carolina 28608
(4-year)

Cape Fear Technical Institute
Marine Laboratory Technology Program
411 North Front Street
Wilmington, North Carolina 28401
(2-year)

Duke University
School of Forestry and Environmental Studies
Durham, North Carolina 27706
(Graduate)

East Carolina University
Institute for Coastal and Marine Resources
Greenville, North Carolina 27834
(4-year)

Elizabeth City State University
Department of Geosciences
Elizabeth City, North Carolina 27909
(4-year)

Guilford College
Environmental Studies Program in Biology, Geology, Political Science and Sociology
5800 West Friendly Avenue
Greensboro, North Carolina 27410
(4-year)

High Point College
Interdepartmental Program in Environmental Studies
High Point, North Carolina 27262
(4-year)

Lenoir-Rhyne College
Environmental Studies Program (Biology, Chemistry, Earth Science, Physics, Social Science)
Hickory, North Carolina 28601
(4-year)

North Carolina State University
Interdepartmental Program in Marine Sciences
Raleigh, North Carolina 27607
(4-year; Graduate)

North Carolina State University
Forestry Department
Raleigh, North Carolina 27607
(4-year)

North Carolina State University
Zoology Department
Raleigh, North Carolina 27650
(4-year; Graduate)

North Carolina State University
School of Agriculture and Life Sciences
School of Forest Resources
Raleigh, North Carolina 27607
(4-year)

Saint Andrews Presbyterian College
Multidisciplinary Program in Environmental Studies
Laurinburg, North Carolina 28352
(4-year)

University of North Carolina at Chapel Hill
Department of City and Regional Planning
Chapel Hill, North Carolina 27514
(Graduate)

University of North Carolina at Chapel Hill
Interdepartmental Program in Marine Sciences
Chapel Hill, North Carolina 27514
(4-year; Graduate)

University of North Carolina at Wilmington
Department of Environmental Studies
Wilmington, North Carolina 28401
(4-year)

Ohio

Antioch College
Environmental Studies Department
Yellow Springs, Ohio 45387
(4-year)

Bowling Green State University
Environmental Studies Center
124 Hayes Hall
Bowling Green, Ohio 43403
(4-year)

Cleveland State University
Urban Studies
Division of Environmental Studies
Euclid Avenue at East 24th Street
Cleveland, Ohio 44115
(Graduate)

Ohio State University
College of Biological Sciences
126 Botany and Zoology Building
1735 Neil Avenue
Columbus, Ohio 43212
(Graduate)

Ohio State University
Division of Environmental Education
124 West 17th Street
Columbus, Ohio 43212
(4-year; Graduate)

Ohio University
Interdepartmental Program in Environmental Studies
Graduate Building
Athens, Ohio 45701
(4-year; Graduate)

Wright State University
College of Liberal Arts
Environmental Studies Program
Dayton, Ohio 45435
(4-year)

Wright State University
College of Science and Engineering
Dayton, Ohio 45431
(4-year)

Oregon

Clatsop Community College
Environmental Technology Program
Astoria, Oregon 97103
(2-year)

University of Oregon
Geography Department
Eugene, Oregon 97403
(4-year)

Willamette University
Inter-Area Studies Program in Environmental Science
Salem, Oregon 97301
(4-year)

Pennsylvania

Allegheny College
Co-op Program in Environmental Resource Management
Meadville, Pennsylvania 16335
(4-year; Graduate)

Beaver College
Environmental Education Program
Glensdale, Pennsylvania 19038
(Graduate)

California State College
Environmental Studies Program
California, Pennsylvania 15419
(4-year)

Carlow College
Biology Department
3333 Fifth Avenue
Pittsburgh, Pennsylvania 15213
(4-year)

Carnegie-Mellon University
Carnegie Institute of Technology
College of Engineering
Energy and Environmental Studies Program
Pittsburgh, Pennsylvania 15213
(Graduate)

Dickinson College
Department of Biology
Carlisle, Pennsylvania
17013
(Certificate)

East Stroudsberg State College
Interdisciplinary Program in Environmental Studies
East Stroudsberg, Pennsylvania 18301
(4-Year)

Edinboro State College
Physics Department
Edinboro, Pennsylvania 16444
(4-year)

Lycoming College
Biology Department
Cooperative Programs in Forestry or Environmental Studies
Williamsport, Pennsylvania 17701
(4-year; Graduate)

Mercyhurst College
Environmental Studies Department
Erie, Pennsylvania 16501
(Certificate; 4-year)

Millersville State College
Earth Sciences Department
Millersville, Pennsylvania 17551
(4-year)

Northampton County Area Community College
Environmental Studies Department
3835 Green Pond Road
Bethlehem, Pennsylvania 18017
(2-year)

Pennsylvania State University
Division of Man-Environment Relations
S-126 Henderson Human Development Building
University Park, Pennsylvania 16802
(Graduate)

Pennsylvania State University
School of Forest Resources
College of Agriculture
University Park, Pennsylvania 16802
(4-year)

Shippensburg State College
School of Behavioral and Social Science
Geography-Earth Sciences Department
Graduate School
Shippensburg, Pennsylvania 17257
(Graduate)

Shippensburg State College
School of Education and Professional Studies
Shippensburg, Pennsylvania 17257
(No degree)

Susquehanna University
Institute for Environmental Studies
Selinsgrove, Pennsylvania 17870
(Certificate)

Villanova University
Civil Engineering Department
Water Resources Engineering Program
Villanova, Pennsylvania 19085
(Graduate)

West Chester State College
Department of Secondary Education and Professional Studies
Environmental (Outdoor) Education Program
West Chester, Pennsylvania 19380
(Certificate)

Westmoreland County Community College
Conservation and Environmental Technology Program
College Station
Armbrust Road
Youngwood, Pennsylvania 15697
(2-year)

Puerto Rico

University of Puerto Rico
Environmental Management Program
Rio Piedras Campus
Rio Piedras, Puerto Rico 00936
(4-year)

University of Puerto Rico
Natural Science Department
Rio Piedras, Puerto Rico 00931
(4-year)

University of Puerto Rico
Arts and Sciences Department
Entomology and Radiobiology Programs
Mayaguez Campus, Mayaguez, Puerto Rico 00708
(Graduate)

Rhode Island

Roger Williams College
Division of Engineering
Urban and Environmental Planning Program
Bristol, Rhode Island 02809
(4-year)

Woonsocket Area Vocational-Technical Facility
Environmental Control Program
400 Aylsworth Avenue
Woonsocket, Rhode Island 02895
(Certificate)

South Carolina

Clemson University
Department of Agricultural Engineering
Clemson, South Carolina 29631
(4-year)

Coastal Carolina College
Science Division
Route 6
Box 275
Conway, South Carolina 29526
(4-year)

University of South Carolina
Interdepartmental Program in Marine Science
Columbia, South Carolina 29208
(4-year; Graduate)

University of South Carolina
Geology Department
Coastal Dynamics Program
Columbia, South Carolina 29208
(4-year; Graduate)

South Dakota

Mount Marty College
Biology Department
1100 West Fifty Street
Yankton, South Dakota 57078
(4-year)

Tennessee

Maryville College
Interdepartmental Program in Environmental Quality
Maryville, Tennessee 37801
(4-year)

University of Tennessee at Chattanooga
Interdisciplinary Program in Environmental Studies
Chattanooga, Tennessee 37401
(4-year)

University of Tennessee at Knoxville
Department of Forestry, Wildlife, and Fisheries
Knoxville, Tennessee 37916
(4-year; Graduate)

University of Tennessee at Martin
School of Agriculture, Soil and Water Conservation Program
Martin, Tennessee 38238
(4-year)

Volunteer State Community College
Science and Mathematics Department
Nashville Pike
Gallatin, Tennessee 37066
(2-year)

Texas

Baylor University
Institute of Environmental Studies
Waco, Texas 76703
(4-year)

Saint Edwards University
Department of Physical and Biological Sciences
Environmental Studies Program
3001 South Congress Avenue
Austin, Texas 78704
(4-year)

Texas A&M University
Geography Department
College Station, Texas 77843
(4-year)

Texas Tech University
Interdepartmental Program in Environmental Studies (Land Use Planning, Management and Design)
Lubbock, Texas 79409
(Graduate)

Trinity University
Environmental Studies Department
715 Stadium Drive
San Antonio, Texas 78284
(4-year)

University of Houston at Clear Lake City
Public Affairs Department
Environmental Management Program
2700 Bay Area Boulevard
Houston, Texas 77058
(4-year; Graduate)

University of Texas at San Antonio
Division of Environmental Studies
San Antonio, Texas 78285
(4-year; Graduate)

Utah

Utah State University
College of Natural Resources
Logan, Utah 84322
(4-year)

Vermont

Johnson State College
Environmental and Scientific Studies Division
Johnson, Vermont 05656
(4-year)

Marlboro College
Chemistry Department
Marlboro, Vermont, 05344
(4-year)

Middlebury College
Interdisciplinary Program in Environmental Studies
Middlebury, Vermont 05753
(4-year)

Southern Vermont College
Environmental Studies Program
Monument Road
Bennington, Vermont 05201
(2-year; 4-year)

University of Vermont
School of Natural Resources
601 Main Street
Burlington, Vermont 05405
(Graduate)

University of Vermont
Interdisciplinary Program in Environmental Studies
1535 Prospect Street
Burlington, Vermont 05401
(4-year)

Virginia

Emory and Henry College
Interdisciplinary Program in Environmental Studies
Emory, Virginia 24327
(4-year)

Ferrum College
Division of Mathematics
Natural Sciences and Engineering
Ferrum, Virginia 24088
(4-year)

Sweet Briar College
Environmental Studies Program
Sweet Briar, Virginia 24595
(4-year)

Virginia Polytechnic Institute and State University
School of Forestry and Wildlife Resources
Blacksburg, Virginia 24061
(4-year; Graduate)

Wytheville Community College
Division of Engineering Technologies and Mathematics
Environmental Technology Program
1000 East Main Street
Wytheville, Virginia 24382
(2-year)

Washington

Central Washington University
Environmental Studies Program
Ellensburg, Washington 98926
(4-year; Graduate)

Eastern Washington State College
Center for Environmental Studies
Cheney, Washington 99004
(4-year)

Everett Community College
Division of Science, Environmental Studies Program
1124 Street S.W. and Navajo Avenue
Everett, Washington 98204
(2-year)

Fort Wright College
Center of Life Studies
Interdisciplinary Environmental Studies Program
West 4000 Randolph Road
Spokane, Washington 99204
(4-year)

North Seattle Community College
Liberal Studies Department
9600 College Way North
Seattle, Washington 98103
(2-year)

Seattle University
School of Science and Engineering
Environmental Studies Program
12th and East Columbia
Seattle, Washington 98122
(4-year)

University of Washington
Institute for Environmental Studies
201 Engineering Annex
Seattle, Washington 98195
(4-year)

Western Washington University
Huxley College of Environmental Studies
516 High Street
Bellingham, Washington 98225
(4-year)

Whitman College
Interdepartmenal Program in Environmental Studies
Walla Walla, Washington 99362
(4-year)

West Virginia

West Virginia College of Graduate Studies
Faculty of Engineering and Science
Institute, West Virginia 25112
(Graduate)

West Virginia State College
Environmental Studies Department
Institute, West Virginia 25112
(4-year)

Wisconsin

Northland College
Interdisciplinary Program in Environmental Studies
1411 Ellis Avenue
Ashland, Wisconsin 54806
(4-year)

University of Wisconsin at Green Bay
Interdisciplinary Environmental Studies Program
Green Bay, Wisconsin 54302
(4-year; Graduate)

University of Wisconsin at Stevens Point
College of Letters and Science
Environmental Studies Program
Stevens Point, Wisconsin 54481
(No degree)

Appendix 3

The Environmental Protection Agency

The wave of indignation about pollution crested in the late 1960's, leading our society to the realization that we are dependent on and part of an ecosystem that we did not invent and must not destroy. Public agitation for new national environmental controls was intense, reflecting the widespread belief that air and water and land could no longer be used as free dumping grounds, that no private interest had the right to despoil the environment.

The Environmental Protection Agency (EPA) was created through an executive reorganization plan designed to consolidate certain Federal Government environmental activities into a single agency. The plan was sent to Congress on July 9, 1970, and EPA was established as an independent agency in the Executive Branch on December 2, 1970.

EPA was formed by amalgamating 15 components from five departments and independent agencies; its creation climaxed years of increasing debate over how to protect Americans from pollution. The forming of the agency marked a realization that local ordinances could not cope with many of the problems facing us and that the piecemeal approach to solving environmental problems merely substituted one form of pollution for another.

The Environmental Protection Agency (EPA) was created to provide a broad, comprehensive approach to the solution of environmental problems: its administrative organization has been designed to make this approach a reality. The new organizational structure makes it easier to identify and to take into account all of the factors bearing on pollution and its control.

In its organization, EPA has an administrator, supported by a deputy administrator and six assistant administrators. Three of the assistant administrators are responsible for "functionalized" activities, that is, activities that cut across all programs. These activities are planning and management, enforcement, and research. The remaining program activities have been grouped under three other assistant administrators on a type-of-pollution basis: air, wastewater, pesticides, noise, drinking water, solid waste, toxic substances, and radiation. The activities carried out by these offices are primarily policy development, standards and criteria development, and support and evaluation of regional activities.

EPA has made progress in decentralizing its operating programs. To insure that EPA is truly responsive to nationwide environmental needs, it has established regional offices in conformance with the standard Federal regional boundaries and has assigned to these offices major responsibilities for carrying out EPA programs and policies. Responsibilities assigned include implementation and enforcement of standards, conduct of monitoring and surveillance programs, and provision of technical and financial assistance to State and local governments. The regional offices are staffed by specialists in each program area, such as air, wastewater, pesticides, and others, and are headed by a regional administrator possessing broad authority to act for EPA in matters within his or her jurisdiction.

Legislation

EPA is responsible for administering Federal laws. In the short time since the agency was established, its mission has broadened considerably owing to the passage of a number of important laws:

☐ The Clean Air Act (as amended in 1970, 1974, and 1977);

☐ The Federal Water Pollution Control Act (as amended in 1972 and as amended by the Clean Water Act of 1977);

☐ The Safe Drinking Water Act of 1974 (as amended in 1977);

☐ The Resource Conservation and Recovery Act of 1976;

☐ The Toxic Substances Control Act of 1976;

- ☐ The Federal Insecticide, Fungicide, and Rodenticide Act (as amended in 1972, 1975, and 1978); and
- ☐ The Noise Control Act of 1972 (as amended by the Quiet Communities Act of 1978).

In addition, EPA has responsibility for monitoring and setting standards under the Atomic Energy Act, which deals with the level of environmental exposure to radiation; and for administering title I of the Marine Protection, Research, and Sanctuaries Act of 1972 (the "Ocean Dumping Act"), which deals with the dumping of wastes into ocean waters. In 1978 President Carter transferred to EPA from the Council on Environmental Quality the task of administering the Federal Environmental Impact Statement process, which is outlined under the National Environmental Policy Act.

Clean Air Act

EPA is required to protect the public health and general welfare by establishing national air quality standards for all important air pollutants. Standards have already been set for six principal pollutants: particulate matter, sulfur oxides hydrocarbons, carbon monoxide, photochemical oxidants, and nitrogen oxides. In addition, EPA is required to set limits on the level of air pollutants emitted from such stationary sources as new power plants, municipal incinerators, factories, and chemical plants. EPA is also required to establish emission standards for new motor vehicles, as well as for hazardous air pollutants such as beryllium, mercury, and asbestos. Vinyl chloride was recently added to the list of hazardous air pollutants.

The States are charged with the responsibility for developing and implementing specific programs for achieving the clean air standards set by EPA. Detailed State implementation plans must be submitted to EPA demonstrating how the standards will be achieved and maintained. Should any State fail to adopt and implement such a plan, EPA is authorized to do so on its behalf.

Citizens are specifically authorized to take necessary legal actions against private or governmental officials failing to meet the provisions of this law.

Federal Water Pollution Control Act (Clean Water Act)

No discharge of any pollutant into navigable waters is allowed without a permit. EPA, or States delegated authority from EPA, may issue such permits based on the toxicity of the pollutant and, for nontoxic pollutants, based on the best pollution control technology the particular industry can afford.

The dumping of any radioactive waste into the Nation's waters is prohibited.

EPA is authorized to issue construction grants to aid municipalities in building wastewater treatment plants and to issue grants to assist States in areawide waste treatment management planning.

EPA is required to conduct extensive research on all aspects of water pollution.

Public participation in the development and enforcement of water pollution control regulations is encouraged. Furthermore, any citizen has the right to take legal action against a water polluter.

Safe Drinking Water Act

EPA is responsible for setting minimum national drinking water regulations to insure that drinking water is safe.

Each State can assume primary enforcement authority over the regulations. If a State does not have primary enforcement authority, EPA will have that authority.

EPA also is authorized to conduct research on health aspects of drinking water and to assist the States in improving the quality of drinking water.

A 15-member advisory council, composed of representatives from State, local, and private organizations, will advise EPA on matters of drinking water administration.

Any citizen may bring civil action against any public water system or Federal agency (including EPA) for violation of the regulations.

One of the unique features of the Safe Drinking Water Act is that it requires water suppliers who violate the regulations to notify their users and the local newspapers.

Resource Conservation and Recovery Act

An extensive program of Federal grants, starting in fiscal year 1978, is authorized to help States and regional governmental agencies plan and carry out solid waste management programs. Grant assistance and technical aid are available for development of waste collection and disposal systems, as well as for development of waste reduction, conservation, and resource recovery methods.

For the first time EPA is required to set standards for the handling of hazardous solid wastes, with power to regulate and enforce these standards. Hazardous waste is defined as any waste that "because of its quantity, concentration, or physical, chemical, or infectious characteristics" may cause death or disease or threaten public health or the environment.

Under EPA guidelines, States must establish rules for the handling of hazardous wastes and issue permits for treatment, storage, or disposal. If States fail to do so, EPA regulations apply. Civil and criminal penalties may be as high as $25,000 per day of violation, a year in prison, or both.

Open dumps throughout the nation are to be phased out over a 5-year period and banned entirely by 1983. EPA must take a national inventory of such dumps and set standards for upgrading them to sanitary landfills. Special assistance is authorized for rural communities, and demonstration grants are provided for small communities coping with large amounts of waste from outside their boundaries.

Extensive research, development, and demonstration projects in solid waste technology are undertaken. These include special studies in the handling of glass, plastics, rubber tires, sewage sludge, and mining wastes. EPA is required to disseminate that information, to educate the public, and to maintain a central reference library on solid waste management.

Toxic Substances Control Act

EPA is given the authority to regulate the production and use of chemicals harmful to public health or the environment. The agency is required to compile a list of all such chemicals (perhaps as many as 35,000) now on the market, to limit the use of those found to be harmful and, if necessary, to ban their production.

If a new chemical substance is scheduled for production, the law requires that EPA be notified of the intended production. If need be, EPA can require that the substance be tested for toxicity and environmental effects before it is marketed. The Act does not apply to drugs, food, food additives, pesticides, radioactive materials, and certain other chemicals required by other Federal laws. Existing chemicals are also subject to various testing requirements.

A special section of the law bans the manufacture of PCB's (polychlorinated biphenyls) as of 1979. These chemicals are now used mainly as insulating fluids in electrical equipment but were formerly used in paints, inks, plastics, and many other products. They are poisonous to humans. They accumulate in the fatty tissues of fish and resist natural decay in the environment.

If EPA believes that a chemical presents an unreasonable risk, it may make rules that limit the chemical's distribution and use or that require certain labeling and disposal methods. A permanent ban on manufacture requires action by a Federal court.

Civil penalties for violating the Act can be as high as $25,000 per violation, with each day of noncompliance constituting a new violation. Criminal penalties can be as high as a $25,000 fine, a year in prison, or both.

Federal Insecticide, Fungicide, and Rodenticide Act

Manufacturers of pesticides must register with the EPA Administrator any insecticide, herbicide, fungicide, or any other substance intended for sale, either in interstate or intrastate commerce, to control or otherwise affect pests in the United States.

Pesticide manufacturers are required to provide scientific evidence that their products are effective for the purposes intended and will not injure humans, livestock, crops, or wildlife when used as directed.

EPA is authorized to classify pesticides for either general use or restricted use. General use pesticides are those that ordinarily will not cause unreasonable, adverse effects on the user when applied according to label instructions. General use pesticides may be used by anyone. Restricted use pesticides are those that may pose an unreasonable risk to the user or environment unless employed with great care. Restricted use pesticides may be used for the most part by or under the direction of certified applicators.

EPA is required to set forth standards for certification of applicators of restricted use pesticides. The individual States will certify applicators through their own programs based on the Federal standards.

The EPA Administrator may cancel and, if necessary to prevent an imminent hazard, suspend the registration of a product if it causes unreasonable risk to humans, animals, or the environment. In such a case, the manufacturer may appeal the decision through established administrative and judicial review procedures.

The EPA Administrator is authorized to issue a "stop sale, use and removal" order when a pesticide already in circulation is found to be in violation of the law.

Containers of all registered pesticides must be labeled according to EPA specifications. The EPA Administrator is required to develop procedures and regulations for storage or disposal of these containers.

EPA is authorized to issue experimental use permits, conduct research on pesticides and health, and monitor pesticide levels in the environment.

Noise Control Act

The EPA Administrator is required to protect public health and welfare by setting acceptable noise levels for products that are sources of noise in the categories of construction equipment, transportation equipment (except aircraft), all motors and engines, and electronic equipment.

To set noise standards, EPA is directed to research and publish information on noise limits required to protect human health and welfare, to identify products that are major sources of noise, and to provide information on techniques for controlling noise.

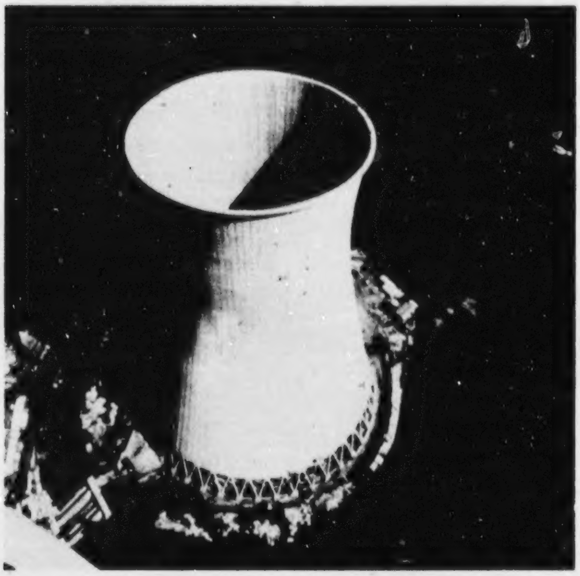
Acting in an advisory capacity, EPA must submit recommendations and propose regulations to the Federal Aviation Administration (FAA) to control aviation noise. The FAA, however, remains directly responsible for regulating aviation noise.

EPA is mandated to require labeling of products as to their noise-generating or noise-reducing characteristics.

Authority for EPA's Radiation Program

The primary authority for EPA's radiation program is provided in Reorganization Order No. 3 of 1970, which created EPA. In addition, the Agency is responsible for managing radiation protection provisions of other important acts:

The Atomic Energy Act of 1954, as amended—Together with Reorganization Order no. 3, this Act gives EPA its "Federal guidance function," requiring the administrator to provide overall guidance to other Federal agencies on all radiation protection matters that could have effects on public health, and to set "generally applicable environmental standards" outside the boundary of nuclear facilities.



Public Health Service Act—Requires EPA to provide assistance to the States and to monitor the environment for radiological effects.

The Ocean Dumping Act of 1972—Requires EPA to regulate the disposal of radioactive waste in the ocean.

The Safe Drinking Water Act of 1974—Requires EPA to establish radiation criteria for the purpose of protecting drinking water.

The Federal Water Pollution Control Act of 1972, as amended (Clean Water Act)—Requires EPA to assess the best practical available technology for protecting water quality and to establish efficient and water quality limits for radiation discharges into the atmosphere.

The Clean Air Amendments of 1970—Require EPA to assess the best practical available technology for protecting air quality and to establish standards for radiation discharges.

EPA has developed three separate but interrelated processes in connection with its legislative mandate. These include determining specific environmental levels for several pollutants (setting standards), carrying out enforcement activities, and, in cooperation with State and local governments, maintaining diversified monitoring programs.

Setting Standards

EPA is responsible for setting standards sufficient to protect the public health and welfare, whether they involve restricting pesticide use or setting emission levels for automobiles. State and local governments may develop additional controls or programs for various reasons, but EPA's direct responsibilities are restricted to the protection of health and welfare.

Enforcement and Monitoring Programs

EPA's philosophy has been to encourage voluntary compliance by private industry and communities or to encourage State and local governments to perform whatever enforcement activities are needed to meet EPA standards. If these agencies fail to produce effective plans for pollution abatement or if they do not enforce the programs they develop, EPA must act under the enforcement provisions contained in most of the major environmental laws passed by Congress.

Several kinds of monitoring processes and activities exist within EPA. Some are broadly based monitoring programs that determine whether pollution levels and emissions are increasing or declining. Others determine if the various abatement programs developed by EPA and State and local governments are as effective as they should be.

Research and Development Programs

Effective environmental action as directed by Federal legislation requires precise technical data on possible threats to health and the environment posed by the various substances that are introduced into the biosphere. The research and development arm of EPA supports the Agency's primary functions of developing and enforcing appropriate regulations and standards by providing such data.

EPA's research program, authorized under the major Congressional acts, allots more than one-fifth of the Agency's operating budget for scientific study at laboratories and field stations:

- To expand and improve environmental monitoring and surveillance so that we can better understand the condition of the environment today, and can be aware of changes, for better or worse, tomorrow. For example, air quality measuring stations throughout the United States routinely measure 40 air pollutants—particles, gases, and liquids. Some 3,000 soil samples are tested annually for pesticide levels. The radiation monitoring program includes collection of air, water, rain, milk, human bone, and food samples for analyses of radioactive nuclides.
- To gather the scientific evidence needed to set new and strengthened environmental quality standards. EPA's research activities are essential if the Agency is to set standards for pollutants. For example, before setting standards for automobile emissions, EPA must study the effects the standards will have on the environment, as well as the effects they will have on the nation's economy.
- To learn the short- and long-range effects of pollution on humans and other life forms. In its Community Health and Environmental Surveillance Studies (CHESS), EPA has investigated on a nationwide basis the effects of air pollution on humans. EPA studies the effects of fertilizers and pesticides that wash from open fields into the Nation's waterways. The Agency also determines the effects on waterways of runoff from industrial installations, poultry and animal processing plants, and phosphate mining operations.
- To speed the research, development, and use of new pollution control methods and equipment. Technology researchers are working to find new and improved methods of solid waste collection, transportation, storage, processing and disposal. They conduct experiments to encourage recycling and resource recovery from solid wastes. One approach being tested involves mixing ordinary municipal solid waste with coal to fuel an electric power generating plant. Because automobiles contribute nearly half of all air pollution in the United States, EPA research programs seek to stimulate development of a virtually pollution-free power system for automobiles.
- To evaluate technical and social changes and their effects on environmental quality. EPA examines the forces that create growth and change in the Nation—transportation policies, tax policies, advertising, government services, technology, environmental regulations, etc. The Agency determines the impact of various possible changes in policy and technology on institutions, and investigates the social and political implications of these changes.
- To improve our knowledge of what happens to pollutants in the environment—of how they move and might change in their journey through the air, water, and land. For example, what are the effects of automobile exhausts on roadside crops? What happens to chemicals that mix together in the air and sunlight?

EPA's diversified research and monitoring programs are managed out of the headquarters office in Washington, D.C. Research laboratories are located in the following cities: Corvallis, Oreg.; Las Vegas, Nev.; Ada, Okla.; Gulf Breeze, Fla.; Athens, Ga.; Research Triangle Park, N.C.; Narragansett, R.I.; Cincinnati, Ohio; and Duluth, Minn. Supplementing these facilities are numerous related resources including watercraft, aircraft, field stations, and monitoring sites.

EPA's research and monitoring components work with other Federal agencies that carry on environmental research and monitoring activities. The Agency also carries out research programs through grants and contracts with academic, research, and industrial communities. Information developed throughout the scientific community is assessed by EPA to obtain the best possible scientific base for action to improve the environment. The Agency cooperates with and exchanges findings with scientists in other nations and in international organizations on common and worldwide environmental research and monitoring programs.

Financial and Technical Assistance

By providing financial and technical assistance to State, regional, and local jurisdictions, EPA serves as a catalyst for environmental protection efforts at all levels of government. EPA grants Federal funds for the construction and operation of various types of facilities to reduce pollution. It also demonstrates new pollution control technology.

The municipal construction grant program is the Agency's best known assistance program. Recognizing that many local governments could not afford to build sewage plants necessary to comply with the Federal Water Pollution Control Act Amendments, Congress voted $18 billion in Federal grants to help do the job. This $18 billion has been made available to cities, towns, boroughs, counties, parishes, districts, and other bodies created by State law to take care of sewage disposal. Funds have also been available to Indian tribal organizations.

The Federal grant will pay 75 percent of the total eligible cost of the sewage treatment project, including the cost of preliminary (facility) planning; the cost of design plans and specifications; and the cost of the actual construction of the treatment facilities. The local government and the State must provide the other 25 percent. Eligible projects include development of new treatment plants, interceptors, outfall sewer lines, pumping equipment, and other equipment needed to operate the system; and expansion or improvement of existing systems.

A major element in the construction grant program is the need for local governments to comply with the public participation requirements in Federal law. Early involvement by the local people—those who are most directly affected by a particular water pollution control program—is vital if delays and needless controversies are to be avoided. EPA cannot approve Federal funds for a construction project unless the public has had an adequate opportunity to take part in planning that project. The purpose of broad public participation in water pollution control is to allow government to be more responsive to public concerns and priorities and to help people understand the government programs and actions.

Communities planning to build sewage treatment facilities must, of course, meet the requirements of their own State and local laws. Those varying State and local laws contain their own requirements for public involvement, such as public hearings, voter approval of bond issues or city or county council approval. But whatever the specific requirements of local and State laws, Federal law sets forth specific requirements for public participation in the grant application process. EPA distributes pamphlets that are intended to help local government officials understand and meet Federal requirements for public participation in the construction grant process.

The construction grant program illustrates the role of EPA's regional offices. The regional offices are responsible for conducting the grant program within the guidance received from EPA headquarters. They have authority to deal directly and conclusively with grant applicants and State agencies. The regional offices are authorized to interpret agency policy; review State and local applications; conduct environmental reviews of applicants' plans; make grant awards and payments; monitor projects; conduct final inspections; and close out projects after completion.

A major responsibility, which is shared by EPA headquarters, the regional offices, and the States, is to assure that construction of waste facilities is not a threat to the environment but does in fact enhance the environment. Under the construction grant process, the possible environmental effects of a project are analyzed when an applicant submits a facilities plan to EPA. The facilities plan includes a discussion of possible environmental effects of the proposed project and the alternatives that were considered during project development.

Sharing Domestic Responsibilities

EPA is by no means the sole governmental body involved in environmental protection. First of all, it shares many of its enforcement authorities with the States in accordance with the principles and procedures established by the Congress in the legislation governing EPA's activities. Moreover, other agencies of the Federal Government conduct activities that directly affect environmental quality in areas outside of EPA's purview.

The Council on Environmental Quality, for example, serves as the President's principal advisor in environmental matters. The National Oceanic and Atmospheric Administration researches long-range global trends affecting the oceans and the atmosphere. The Department of Transportation is concerned with highways, railroads, and air transport. The Department of the Interior administers public lands and natural resources. The Department of Energy is responsible for coordinating and managing a national energy policy. The Department of Housing and Urban Development, the Department of Defense, the Department of Agriculture, and the Department of Health, Education, and Welfare are other departments carrying out activities that affect the environment.

Environmental Impact Statements

On January, 1970, the President signed into law the National Environmental Policy Act (NEPA), which declared a national policy to encourage productive and enjoyable harmony between man and his environment. It was under NEPA that the Council on Environmental Quality was established in the Executive Office of the President to assist the President in assessing environmental problems and in determining ways to solve them.

To insure that environmental amenities and values are given systematic consideration equal to economic and technical considerations in the Federal decisionmaking process, NEPA requires each Federal agency to prepare a statement of environmental impact in advance of each major action that may significantly affect the quality of the human environment. Such actions may include new highway construction, harbor dredging or filling, nuclear power plant construction, large-scale aerial pesticide spraying, river channeling, munitions disposal, and bridge construction.

Each statement must assess in detail the potential environmental impact of a proposed action, and all Federal agencies are required to prepare statements for matters under their jurisdiction. As early in the decisionmaking process as possible, and in all cases prior to agency decision, an agency prepares a draft statement for review by appropriate Federal, State, and local environmental agencies as well as the public. After comment from the agencies and interested parties, the statement is prepared in final form, incorporating all comments and objections received on the draft and indicating how significant issues raised during the commenting process have been resolved. Both draft and final statement are filed with EPA and made available to the public.

Impact statements are popularly called EIS's (Environmental Impact Statements). Each environmental impact statement must include:

☐ A detailed description of the proposed action including information and technical data adequate to permit a careful assessment of environmental impact.

☐ Discussion of the probable impact on the environment, including any impact on ecological systems and any direct or indirect consequences that may result from the action.

☐ Adverse environmental effects that cannot be avoided.

☐ Alternatives to the proposed action that might avoid some or all of the adverse environmental effects, including analysis of costs and environmental impacts of alternatives.

☐ An assessment of the cumulative, long-term effects of the proposed action including its relationship to short-term use of the environment versus the environment's long-term productivity.

☐ Any irreversible or irretrievable commitment of resources that might result from the action or which would curtail beneficial use of the environment.

A final impact statement must include a discussion of problems and objections raised by other Federal, State and local agencies, private organizations, and individuals during the draft statement's review process.

In addition to preparing environmental impact statements for its own actions, EPA reviews other Federal agencies' environmental impact statements touching any aspect of EPA's responsibilities centering around air and water pollution, drinking water supplies, solid waste, toxic substances, pesticides, radiation, and noise. In addition to reviewing statements filed by Federal agencies, EPA frequently reviews as a technical service the statements filed by States and other jurisdictions having legal requirements similar to the requirements under NEPA.

Periodically, EPA lists in the Federal Register statements it has reviewed and commented on, identifying the nature of its comments. For each proposed action, the list generally indicates a lack of EPA objections, a request for more information, or an objection to the action on environmental grounds.

EPA's obligation to review proposed federally supported actions extends beyond that of other agencies because EPA is the principal Federal regulator of pollution.

Under section 309 of the Clean Air Act, EPA must "review and comment in writing on the environmental impact" of any legislation, action, or regulation proposed by any Federal agency if it affects matters related to EPA's jurisdiction. If EPA determines that any proposed activity is unsatisfactory from the standpoint of public health or welfare or environmental quality, that determination must be published.

EPA notifies the public of these comments. Generally, EPA has no authority to stop a project sponsored by another Federal agency; it acts only in an advisory capacity.

Citizen Action

EPA welcomes the public participation of citizen organizations, for informed citizen groups are an essential force for environmental improvement. Citizen organizations are uniquely qualified. They are independent of both government and industry. They can focus public attention on what is and is not being done. They articulate the public's desire for a better environment; they attract press attention, which, in turn, helps nurture the climate of public opinion necessary for action.

Law enforcement cannot be effective without popular support. This is especially true in pollution control, which often requires changes in values in order to break the pattern of business and pollution as usual. With their healthy skepticism, organized citizen groups have already demonstrated their great capacity to prod government and industry to action.

Government and industry have clear environmental responsibilities, of course. The purpose of effective citizen action is not to subvert those responsibilities, but to make sure they are honored. Government and industry have the "experts" on their sides, but citizen organizations often have their own expertise to contribute to environmental decisionmaking.

Moreover, while environmental decisionmaking must be based on the best available scientific and technological information, value judgments—social decisions—are ultimately required. And these social decisions must reflect the public will, for the environment belongs to the public, not just to the "experts" in the government agency or industry immediately involved in a particular decision. When risks must be measured against benefits, when economic and environmental values must be weighed, the public has the right and the obligation to make its views known.

Organized citizen groups are the mechanism through which public opinion is best applied to environmental decisionmaking: they magnify the views of like-minded individuals; they illustrate the concept of participatory democracy.

As the Federal agency charged by law to enforce the pollution control legislation enacted by Congress, EPA encourages the involvement, and even the constructive criticism, of citizen organizations. To make this process as productive as possible by achieving ecological health, EPA has prepared guides for effective citizen action. General information has been prepared by the Agency concerning how to become informed on environmental issues; how to go about selecting targets for action; how to influence legislators; how to fight for funds; how to use the news media; and how to make use of public hearings.

Citizen groups alone have the dedication, drive, and independence to carry on three fundamental missions in pursuit of a better environment:

☐ To insure that there are adequate environmental protection laws at the community, State and Federal levels, and adequate appropriations and staff to carry out those laws;

☐ To encourage control agencies and polluters to move steadily toward compliance with environmental laws; and

☐ To keep the public informed of the success or failure of environmental protection programs.

The environmental impact statement procedure is one illustration of the public's opportunity to participate not only in EPA decisions but also in decisions of other agencies. Each draft environmental impact statement must be made public by the responsible agency at the time it is circulated for comment, a date not less than 90 days before the proposed action. Comments must be made available also, and the final statement must include a discussion of the objections and problems raised in comments on the draft. The final statement must be made public at least 30 days prior to the proposed action.

Statements are announced in the Federal Register, but many agencies have supplementary procedures to reach interested citizens. EPA, for example, generally notifies the press (1) when a decision is reached to issue an impact statement, (2) when a draft or final statement is prepared, and (3) when comments on other agencies' statements are issued. Interested parties may view EPA's own impact statements or EPA's comments on the statements of other agencies by contacting EPA headquarters in Washington, D.C., or any of its 10 regional offices. The Agency welcomes public comment.

EPA does not distribute impact statements prepared by other agencies. These are available directly from the agencies bearing primary responsibility.

Interested persons may submit comments to agencies on any impact statement issued by those agencies. Individuals believing that a draft statement is inadequate may offer written comments on the draft. If a person believes the disposition of his or her comments in a final statement to be inadequate, that person may so notify the agency involved and inform the Council on Environmental Quality (CEQ). In addition to these mechanisms for public participation, many agencies provide for public hearings not only at various stages during the performance of their statutory missions, but during the impact statement process itself.

Workforce Activities

By providing technical assistance to State, regional, and local jurisdictions, EPA serves as a catalyst for environmental protection at all levels of government.

The Agency provides direct training to personnel from Federal, State, and local pollution control agencies, as well as to personnel from industrial firms, in order to insure continued technical competence in the pollution control field. Most EPA direct training courses last about a week, and Continuing Education Units are awarded for the satisfactory completion of courses. Besides providing classroom instruction, the training centers develop instructional packages, training aids, and course materials that can be used by State training operations.

In addition, most of EPA's limited number of fellowships are awarded to employees of State and local pollution control agencies, thereby helping these personnel upgrade their formal training. Colleges, universities, and other training institutions receive EPA training grants making it possible also for these institutions to upgrade the level of training offered to pollution control personnel.

EPA makes grants to States, localities, and regions to carry out workforce programs. In addition, the Agency awards broad program grants to assist States in developing and improving programs for reducing pollution. There is no statutory requirement that agencies use the broad program grants to establish training programs, but EPA regulations require that State programs contain provisions for training. Control program grants are administered through EPA regional offices with headquarters guidance.

Since its establishment in 1970, EPA has supported the training of pollution control personnel; in addition, the public awareness activities of the Agency help create among the general population an understanding of environmental problems.

Public Awareness Activities

EPA has a broad program for keeping the public up to date on environmental issues. The Agency maintains visitor centers at the headquarters office in Washington, D.C., at its 10 regional offices, and at its research installations around the country. The level of activity varies from center to center, but some centers provide classes almost daily. Students range from elementary through college age. Presentations cover what EPA is doing to protect the environment, as well as what individuals and groups can do. Many persons just drop in and look around. Pamphlets and exhibits describe the causes of pollution, the environmental problems confronting humans, and the technology for pollution control. The visitor centers' staffs conduct many of the classes, but they also draw on experts throughout the Agency for specialized presentations.

Many EPA installations also have speakers' bureaus that receive requests for speakers and maintain files of biographical information on employees who can make presentations. When a speakers' bureau at an EPA installation receives a request for a speaker, it finds an employee qualified to make the presentation and sends a biography to the school or other organization. Speakers' bureaus and visitor centers often work in cooperation with one another. EPA speakers have access to EPA films, pamphlets, decals, and other materials.

Schools, civic organizations, and other groups may borrow EPA films. Although films are not produced strictly for classroom use, they are helpful in documenting the case for environmental cleanup.

The Office of Public Awareness prepares news releases and TV briefs announcing Agency actions and bringing the public up to date on environmental issues.

EPA's Public Information Center handles public requests for information on the environment and pollution control, as well as on EPA activities. Available resources include career information, a glossary of environmental terms, discussions of environmental control laws, suggested classroom activities for teaching about pollution, coloring book presentations and other materials.

The President's Environmental Youth Awards

EPA has established the President's Environmental Youth Awards to recognize the accomplishments of young persons who, by becoming active in their communities, have become true environmentalists. This program encourages schools, summer camps, and groups to organize local environmental protection programs to transform the increased environmental awareness among today's young people into positive community involvement.

Summer campers, youth group members, and students from kindergarten to the twelfth grade are eligible to receive awards for their work on environmental projects, either as individuals or as participants in group efforts. The only requirement is that the projects be sponsored by an adult representative of the local school, camp, or group.

Although the President's Environmental Youth Awards program is administered nationally by EPA, its focus is entirely on the local community. The community is where the environmental projects are conceived, the work done, and the benefits realized. Projects are evaluated and awards are granted locally by members of the communities involved.

Each project sponsor must organize a local "awards panel" to advise project participants, determine on what basis awards should be made, decide who should receive awards, and make arrangements for presenting the awards.

The membership of the awards panel should ideally reflect a good cross section of the community and include representatives of the sponsor's organization (in the case of a school, both faculty and students), community leaders, members of environmental action groups, local media representatives, and others.

Awards panelists from such varying backgrounds can successfully gain the support of many local organizations and individuals.

Almost every kind of scholastic endeavor has an application to environmental affairs:

☐ General science students can study noise pollution and solid waste management; chemistry students can analyze pollution content in air and water; biology students can investigate the effects of environmental changes on plant and animal life, while psychology students can study the effects of environment on human behavior.

☐ Social studies students can project what impact future conservation measures might have on the American lifestyle; civics students can examine the roles zoning and planning agencies play in land use; history students can identify local historic sites and significant architecture, showing how existing structures can be adapted to new uses.

☐ English students can write environmental-related articles for local newspapers; modern language students can translate the findings of environmental projects for non-English-speaking citizens; drama students can write skits on local environmental problems and present them before club meetings and other community events; while art students can design and construct the sets.

☐ Economics students can conduct cost-benefit analyses of community recycling programs; and mathematics students can devise computerized carpooling systems.

The program helps young persons learn concepts in environmental protection. Of the 110,000 summer camps and thousands of youth groups in the country, each one can become an environmental force within the community.

EPA tries to integrate all of its public awareness activities into a comprehensive program for maintaining citizen support of pollution control activities. Without the backing of the American public, EPA cannot enforce pollution control laws.

Sharing International Responsibilities

It is now universally recognized that the world's environmental problems cannot be solved by the efforts of any one nation. Pollution does not recognize political boundaries. The air and streams of the world that have absorbed discarded byproducts of industrial and agricultural activity have dispersed their cargoes much more efficiently than would have been thought possible a few years ago. The dangers of environmental degradation are now worldwide.

The United Nations Conference on the Human Environment, which was held in Stockholm, Sweden in 1972, marked the first coordinated effort by the nations of the world to alleviate their common ecological problems. The conference focused on developing uniform international pollution control standards and set forth a list of priorities to protect the environment. It also served to underscore some of the major differences between the industrial nations and the developing countries. The economic demands of developing nations often conflict with efforts to protect the environment.

Through its Office of International Activities (OIA) EPA works with other countries on the entire range of environmental problems. OIA collaborates with the Department of State and other U.S. Government agencies as appropriate.

Many activities at the international level do not have the drama of treaties or international agreements. Frequently, they involve the nonglamorous and routine hard work that is a necessary first step toward coordinated international action. The field of environmental research is a good example. EPA cooperates with organizations in foreign countries. In many disciplines, our knowledge regarding the interaction between man and his environment is incomplete. EPA invests time and money to assist foreign pollution abatement efforts that could be applicable in our country. One approach is the exchange of technical information between EPA and its counterparts in other countries. This helps us to keep abreast of newly discovered techniques and eliminates the wasteful duplication of effort.

Occasionally, EPA enters into contracts with foreign organizations for specific studies and services. There have been contracts under which oil companies in England have developed information for EPA regarding methods to reduce sulfur oxide emissions from factories. Under other contracts, foreign universities have abstracted and indexed foreign language scientific literature for EPA.

Many of these projects are financed through the Special Foreign Currency Program, which employs the so-called "counterpart funds" generated under Public Law 480 of the 83rd Congress. When the U.S. Government sells surplus agricultural commodities, it is paid in the currency of the receiving country rather than in dollars. To the extent that these funds are not needed for normal U.S. Government expenses there they are set aside and Congress can then earmark portions for specific projects. Counterpart funds made possible research in Yugoslavia regarding air pollution caused by copper smelting. A recently completed study in Poland concerned with the carcinogenic (cancer-causing) material in airborne particulate matter was carried out in the same fashion.

EPA has been given the responsibility for setting standards regarding the environmental impact of imported products. In general, these standards are the same as for those produced at home, although the law does provide for exceptions when required for national security. For example, imported automobiles must comply with U.S. standards for air pollution control equipment. Also, pesticides that are produced in a foreign country must be registered with EPA before they can be sold in the United States. Food stuffs that are imported into the United States can be restricted if they contain levels of pesticides that are dangerous for human consumption.

EPA also has authority to require abatement of air and water pollution that originates in the United States and affects a foreign country. When an international organization or a foreign nation complains that some activity in the United States is causing air pollution that endangers persons in a foreign country, the EPA Administrator may call a conference of the air pollution control agencies having jurisdiction over the source of the pollution. The Secretary of State, on his own initiative, may also request EPA to convene a conference. At the conference, the foreign country affected has the same status that a State air pollution control agency would receive in domestic situations. The procedures for controlling water pollution originating in the United States and affecting a foreign country are quite similar, but in this case the complaint must come from the Secretary of State.

The activities cited here do not ordinarily create headlines, but they do constitute the necessary first steps toward coordinated international action to save the earth. We must move faster to clean up our own environment and help other nations do the same. Already international organizations are developing action programs, and several countries now have agencies specializing in pollution control.

EPA bears a heavy responsibility to advance this effort. We have the resources and the experience. Other countries look to us for advice, moral support, and technical assistance. Ours will be a major force in shaping the quality of our planetary environs for years to come.

Index

218

Page
Air Chemist 62
Air Engineer 63
Air Scientist 64
Air Technician 66
Air Technician, Meteorology 68
Agricultural Chemicals Inspector 88
Agricultural Chemist 89
Agricultural Pest Control Specialist 89
Agricultural Services Biologist 90
Aquatic Biologist 34
Audiologist 54
Audiometrist 55
Basin Operator 31
Biometrician 68
Chemical-Laboratory Technician 121
Chemical Radiation Technician 112
Chemist, Wastewater Treatment 19
Chemist, Water Purification 13
Conservation Officer 74
Ditch Rider 32
Drafter, Water and Sewer 35
Emergency Services Radiation Coordinator 113
Engineering Aide 123
Engineering Technician 123
Entomologist 91
Entomology Field Assistant 92
Environmental Economist 124
Environmental Epidemiologist 92
Environmental Lawyer 125
Environmental Lobbyist 126
Estuarine Resource Technician 36
Fish Biologist 75
Fish Culturist 76
Forester 77
Forest Technician 79
Hazardous Waste Management Specialist 93
Health Physicist 113
Hydrographer 37
Hydrologic Engineer 37
Hydrologist 38
Industrial Hygiene Chemist 93
Industrial Hygiene Engineer 127
Industrial Hygienist 128
Industrial Waste Chemist 129
Industrial Waste Inspector 20
Industrial Waste Sampler 21
Industrial Water-Treatment Engineer 39
Laboratory Aide 130
Laboratory Technician,
  Wastewater Treatment 21
Land Planner 80
Landscape Architect 81
Meteorologist, Air Quality 69
Meter Repairer 14
Microbiologist 22
Noise Engineer 56
Noise Specialist 57
Noise Technician 57
Oceanographer 40
Occupational-Health Nurse 130
Oil Pollution-Control Engineer 45
Park Ranger 82
Pest Control Helper 94
Pest Exterminator 95
Pesticide Control Inspector 95
Pesticide-Use Medical Coordinator 96
Photo-Inspection Technician,
  Wastewater Collection 23
Physician 131
Plant Physiologist 97
Pump-Station Operator 14
Radiation Laboratory Technician 115
Radiation Monitor 116
Radiation Protection Engineer 117
Radiation Protection Specialist 117
Radiological Instrument Technician 118
Refuse Collection Superintendent 104
Refuse Collection Supervisor 105
Refuse Collection Truck Operator 105
Registration Specialist
  (Agricultural Chemicals) 98
Resource Recovery Engineer 106
Sanitary Engineer 41
Sanitation Inspector 107
Sewage-Disposal Worker 23
Sewer Maintenance Worker 24
Superintendent,
  Wastewater-Treatment-Plant 25
Supervisor, Waterworks 15
Supervisory
  Wastewater-Treatment-Plant Operator 26
Toxicologist 99
Treatment-Plant Instructor 49
Treatment-Plant Mechanic 27
TV Technician, Wastewater Collection 27
Vector Control Assistant 100
Waste Management Engineer 107
Waste Management Specialist 108
Wastewater-Treatment-Plant Attendant 28
Wastewater-Treatment-Plant Operator 29
Water-and-Sewer Systems Supervisor 31
Water Control Supervisor 33
Water-Filter Cleaner 16
Water-Meter Reader 17
Water Pollution Analyst 42
Water Pollution-Control Engineer 47
Water Pollution-Control Inspector 48
Water Pollution-Control Technician 44
Watershed Tender 33
Water-Treatment-Plant Operator 17
Wildlife Biologist 83